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REGULATION OF FISHING EFFORT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

REGULATION OF FISHING EFFORT

With special reference to Mediterranean trawl fisheries

by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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PREPARATION OF THIS DOCUMENT

At its Fourteenth Session held in Nantes, in October 1978, the General Fisheries Council for the Mediterranean (GFCM) recognized that the formulation and implementation of national plans to control fishing effort were of major importance. It agreed however that this matter raised very serious problems and that, when formulating such plans, it was important to take both positive and negative aspects of past experience into consideration. It recommended that the Secretariat undertake a study on the rationale for government intervention and the means which could be employed in the light of past experience, in controlling fishing effort. It also recommended that the study should indicate the results obtained by those Mediterranean countries which had tried to control effort, and that it should include a bibliography of the major studies devoted to this topic.

Peter H. Pearse, Professor of economics at the University of British Columbia, Canada, agreed to prepare the study.

The scope of the analysis of the problem of controlling fishing effort by Prof. Pearse and the information contained in the report, have application beyond the Mediterranean area. It was therefore decided to publish the study in the series FAO Fisheries Technical Papers, to make it available to the entire fishing community.

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ABSTRACT

This report deals with the general problem of regulating fishing effort and, in particular, with methods of controlling the expansion of fishing capacity in commercial fleets. In the first part, the author exposes the rationale for government intervention and the various management problems which may have to be considered by a regulatory policy; he then identifies a number of criteria that are likely to guide governments in a selection of alternative approaches to management. Part II deals more directly with policy development in Mediterranean trawl fisheries; it summarizes current arrangements in several countries and suggests management measures which might help in solving the problems of overcapacity which affects the trawl fishery, leaving to the countries the choice of appropriate measures according to their own socio-economic and political context.

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PRÉCIS

This report deals with the problem of regulating fishing effort and, in particular, with methods of controlling the expansion of capacity in commercial fishing fleets. These issues are examined in the context of the trawl fisheries of the Mediterranean.

The report begins in Part I with a short exposition of the rationale for government intervention to regulate commercial fishing capacity and effort. The observed tendency of fishing fleets to expand beyond the capacity required to efficiently harvest the resources is explained by the financial incentives that influence fishermen's behaviour whenever entry to fisheries is unrestricted and resources are exploited as common property. In these typical circumstances, any sustained profits in a fishery will, in the long run, attract new fishing enterprises into the fishery and induce existing enterprises to expand their fishing power, until costs rise or yields fall, or both, sufficiently to eliminate the profits. This explains why high earnings are only temporary phenomena, typically associated with development of new stocks, new technology or increased market prices, and prevail only until the incentives to expand capacity is manifested.

The result of these forces is that fishing capacity normally becomes excessive; and because capital and labour are thus employed excessively and wastefully their earnings are usually low. Moreover the unnecessarily high costs dissipate the potential economic values that the fish resources are capable of yielding. In the more valuable fisheries, this general tendency toward overcapacity and excessive fishing effort leads to overfishing and resource depletion as well. As these perverse trends have been manifested increasingly in recent years, many fishing nations have begun to explore corrective policies.

The following section distinguishes among several management problems that relate to the design of regulatory policy, namely the problems of: (i) achieving the correct composition of catch; (ii) achieving the correct level of catch; (iii) maintaining economic efficiency in the fishing process, and (iv) ensuring an efficient distribution of effort between stocks and fishing grounds. Solutions to these problems call for different control measures. This report focuses attention on the last two of these problems.

The next section identifies a number of criteria that are likely to guide governments in selecting among alternative approaches to rationalizing fisheries.

Issues in evaluating a regulatory system are:

its effectiveness in controlling expansion of fishing capacity

its effect on fishing technology

its adaptability and robustness in the face of inevitable changes in fishing technology, costs, fish prices and the availability of resources

its effect on the distribution of effort

the way it will distribute the economic gains from rationalization among fishermen, vessel owners, the government and others

the extent to which it would cause dislocation and affect employment

its administrative complexity and cost.

These criteria provide a framework for evaluating the main approaches to regulating fishing effort in the next section of the report. The traditional types of restrictions on gear, fishing time and the location of fishing, while often serving an important function in protecting young fish and otherwise maintaining the productivity of stocks, are not suitable means of regulating total fishing effort and will usually aggravate economic

inefficiencies if used for this purpose. Three approaches to the problem that are theoretically capable of maintaining fleets at an efficient size and structure are: (i) direct restrictions on vessels; (ii) taxes or royalties on the catch, and (iii) quantitative rights or vessel quotas. These are evaluated in turn in light of the several criteria identified earlier.

Most experience with controls on fishing capacity so far, including that of Mediterranean countries, has been with the first of these, involving administratively simple restrictions on the number of vessels or on some dimension of their fishing power (such as engine horsepower). The weakness of this approach is that it is necessary to apply the restrictions to one (or a few) clearly identifiable and measurable dimensions of fishing power, and as soon as the restriction becomes binding in a profitable fishery it will create incentives to substitute other factors in the fishing process for the restricted factors. Thus experience has shown that if only the number of vessels is restricted these incentives will lead to the introduction of larger vessels and if their tonnage or horsepower is limited, vessel owners will find means of increasing fishing power by other means. Because the technology of semi-industrial fishing is flexible, such simple restrictions may not be effective in preventing further expansion in capacity, and experience so far suggests that much of the potential gains may be dissipated in distorted technology.

A royalty or tax on landings, if it were adjusted to the appropriate level, would reduce fishermen's returns sufficiently to force all surplus capacity out of the fishery and compel the remainder to adopt the most efficient size and scale of fishing units. This theoretically attractive approach suffers two serious disadvantages. First, to achieve the desired result, the levies on landings would have to capture all of the value of the catch in excess of minimum harvesting costs (i.e., the total resource rent). This precludes any improvement in the incomes of fishermen or vessel owners. Second, the charges would have to take account of the varying value of different species and of different areas, and they would have to be constantly adjusted in response to changing catching costs, fish prices and other influences. This degree of flexibility in levying charges is not likely to be readily achievable by most regulatory agencies, and even if it were, this system implies a formidable burden in the form of data requirements, production analysis, administration and enforcement. Not surprisingly, no government has adopted this approach to rationalization. Nevertheless, charges of this kind can provide a valuable supplement to more practicable techniques.

Quantitative rights are frequently used to regulate the use of other natural resources, and there is a growing number of examples of their use in fisheries. In the simplest case, this approach involves allocating the total allowable catch among the participating fishermen by means of transferable rights to take specific quantities of fish. This system has the unique attraction of eliminating the fundamental cause of overcapacity and waste, namely the incentive fishermen in other circumstances have to increase their fishing power in order to protect and enhance their uncertain share of the catch. A regulatory system based on quantitative rights, or vessel quotas, has several other superior features: it facilitates regulation of the catch; it is resilient to changing costs and prices; it provides fishermen with greater security; it can be simple to administer because it creates incentives for fishermen to behave efficiently in their own interests, and importantly, it can be supplemented with a variety of taxes or royalties to achieve any desired division of the financial gains from rationalization between fishermen and the government.

However, effective enforcement of such a regulatory system requires reliable data on landings, and the lack of a reliable, routine system of recording landings in many European countries presents a serious obstacle to the introduction, at present, of this otherwise attractive technique.

Part II deals more directly with policy development in Mediterranean trawl fisheries. It begins with a brief sketch of the structure of Mediterranean fisheries, followed by a summary of the current arrangements relating to the management of fishing effort in six important Mediterranean fishing countries - France, Greece, Italy, Spain, Tunisia and

Yugoslavia. Each of these is described in more detail in Appendix I. Some type of vessel licence is required in all of these countries, but there is considerable variation in the form of these devices and in the extent to which they are used to control fleet development.

France and Spain have the most restrictive policies. In France licences limit the number of vessels and legislation limits the engine power of individual vessels. The licences in Spain authorize each vessel to employ a specific amount of horsepower, and because no new licences are being issued, the total power of the fleet is limited. Most of the stocks exploited by trawlers off Italy, as elsewhere in the northwestern Mediterranean, are suffering from excessive fishing pressure, but Italy has not yet taken any official steps to restrict growth in fishing capacity. However, some well organized fishermen's cooperatives, mainly on the Adriatic coast, have taken voluntary measures to regulate fishing effort.

In both Tunisia and Yugoslavia a state enterprise fishing sector exists alongside an independent private sector, and in both countries the government is encouraging fisheries development in order to fully utilize the resources off their coasts. Vessel licences in Yugoslavia are not used to restrict access to fisheries. Tunisia alone among the countries examined, has taken measures to regulate capacity and effort discriminatingly among fishing zones. Greece is an intermediate case, insofar as the scope for increased catches is uncertain, and policy is directed mainly to fleet modernization rather than to expansion. None of these countries has taken measures to reduce fishing capacity, although in some cases capacity exceeds considerably the level required to efficiently harvest the available resources.

The final section of the report draws a series of conclusions from the experiences of Mediterranean and other countries with rationalization programmes, and from economic analysis. These conclusions are explained and presented as a series of suggestions for the design of regulatory arrangements suitable for trawl fisheries as follows:

> Fisheries authorities should initiate measures to regulate fishing capacity early, preferably well before capacity has reached a level capable of fully harvesting the desired catch.
>
> Where fisheries still have scope for expansion, governments should, as an initial step, introduce a simple form of licensing to provide an administrative mechanism for identifying the fleet and to monitor its development. Licensing of vessels will usually be most appropriate and practicable.
>
> Before it becomes desirable to restrict further fleet expansion, the licensing system should be modified to authorize some basic dimension of the licensed vessels' capacity, such as engine power or tonnage.
>
> Before the fleet's desired capacity is reached, any subsidies for vessel construction should be abolished.
>
> As the fleet's capacity approaches the desired level, the authorities should announce their intention to issue no additional licences, except for vessels already under construction and other special cases.
>
> In the case of fisheries which are already overexpanded before any controls are introduced, initial restrictive measures should be implemented with as little advance notice as possible, in order to minimize pre-emptive expansion of fishing power.
>
> In such cases, it will usually be necessary to grant licences to all fishing units established in the fishery. The criteria for establishing eligibility should be clearly specified and rigorously enforced.

In addition, a systematic appeal procedure should be provided to adjudicate eligibility for licences in special cases, and precautions should be taken against illegitimate pressures to issue additional licences.

Licences should be transferable and divisible, to enable flexible improvement and replacement of fishing units within the total limitations of the fleet and to provide a mechanism for adjusting fleet capacity through market purchases.

The term of initial licences should be long enough, or be renewable with sufficient certainty, to provide adequate security to vessel owners for efficient investment and financial planning of their fishing enterprises. In many cases, however, a finite term will facilitate future changes in the structure of fishing rights.

Some sort of charge for the privileges conveyed under licences should be provided for at the outset or at an early stage in a rationalization programme. Initially, the amount of the levy might be only nominal, but it should preferably be recurrent. The charge is likely to be more acceptable if at least some of the revenues are initially earmarked for the purposes of advancing the rationalization programme.

Initial licensing should be compulsory under law for all vessels engaged in the relevant fisheries, and it should include all the fisheries within the particular jurisdiction that can employ the type of vessels licensed.

Consistent with the transferability of licences, licensing of new vessels should be permitted on the condition that the owners simultaneously retire an equal amount of licenced capacity. To avoid subsequent difficulties, it may be desirable to require that a newly built vessel can be introduced into a restricted fishery only if the required licence is provided for before the vessel is constructed.

A programme of continuous monitoring should be initiated as soon as restrictive licensing is introduced in order to assess the impact of the controls on the fleet's capacity and technology, and to assess the need for supplementary measures.

Measures should be taken to enable regulation of the distribution of fishing effort between stocks and regions. This requires identification of suitable management zones and selection of a control mechanism. Regulation by means of supplementary licences for each zone may be most practicable and effective.

Where fleet capacity is excessive, regulatory authorities should implement a "buy and retire" programme, intervening as a purchaser in the market for licences to withdraw licensed capacity without causing involuntary dislocation. There may be administrative and political advantages in funding this programme through earmarked revenues from licence fees.

In the longer term, as a fishery becomes profitable under a rationalization programme, consideration should be given to the possibility of introducing royalties on the catch, to dampen vessel owners' incentives to expand capacity by altering technology. To the extent that it is administratively feasible, the royalty rates should vary among zones and over time according to variations in the potential net value of the catch.

To establish a permanent policy framework for maintaining an efficient industrial organization, regulatory authorities should carefully examine the feasibility of converting vessel licences to quantitative rights.

Governments should encourage development of strong, regional and local organizations of fishermen and vessel owners, and carefully explore opportunities for utilizing their talents and capabilities in managing regulatory programmes.

The social, political and economic circumstances of different countries, and the condition of their fisheries, vary so much that no single regulatory policy is suitable for all. The design of regulatory mechanisms must take account of the peculiarities of each case. The suggestions here are therefore intended as general proposals, to be considered, modified or rejected in the light of varying circumstances.

INTRODUCTION

Major fishing nations around the world are searching for suitable means for regulating effort in their commercial fisheries. The reasons for this new interest are several. One is the growing evidence of overfishing of many of the most valuable stocks, and the consequent concern to restrain catches. Another is the need for more effective regulatory machinery as a result of recent extensions of fisheries jurisdictions which have greatly increased the responsibilities of management agencies. A third is the recent rapid changes in fishing technology and in fish values, which threaten to aggravate the problem of controlling excessive fishing capacity in many fisheries. Another is the growing understanding among fisheries administrators, that the full social and economic benefits from fisheries resources can be realized only if biological management of stocks and yields is supplemented with controls over the deployment of fishing effort, thus adding an economic dimension to a problem traditionally regarded as one of biological regulation.

In Mediterranean fisheries most of these technical, economic and political pressures can be observed, and they are converging to generate a need for new, more sophisticated, regulatory policies. Growing appreciation of this need is reflected in recent documents of the General Fisheries Council of the Mediterranean (FAO, 1978a; FAO, 1978b) and in the Council's 1978 decision to appraise itself of alternative techniques for regulating fishing effort and of their implications (FAO, 1978c). This report is a result of that decision.

The Council's initiative in sponsoring a review of the problem of effort regulation is therefore timely. Moreover, the Council itself affords a suitable institutional mechanism for the kind of international coordination needed to deal with such problems. GFCM's potential effectiveness has already been demonstrated in joint measures to improve statistical data and to regulate the selectivity of gear, and it seems appropriate to begin to examine measures that will ensure that biological gains will be reflected in economic and social benefits.

This report has been written from the point of view of a Canadian, which has given me both advantages and disadvantages. While I have had the benefit of close observation of Canada's relatively extensive experiments in rationalizing commercial fisheries, that experience cannot be casually transferred to the very different circumstances of the Mediterranean. Moreover, the Mediterranean fisheries are very diverse, and their structure and circumstances are not all well documented. I have had only a few weeks to acquaint myself with Mediterranean conditions, and notwithstanding the generous assistance I have had from others, I cannot claim more than a superficial knowledge of fishing industries around the Mediterranean. I am not sufficiently knowledgeable to feel comfortable in documenting, let alone appraising, the policies of regulatory authorities in Mediterranean countries. However, I have been asked to examine and evaluate these policies, and so, in the interests of promoting further discussion and analysis, I have commented on some matters less cautiously than prudence would otherwise dictate. Readers will, I suspect, find evidence of my ignorance of Mediterranean fisheries, and for this I apologize in advance.

As the author of this report, I am solely responsible for its contents. I must emphasize this because I have had a great deal of assistance from others which I want to acknowledge without implying that they are in any way responsible for mistakes or inadequacies in what I have written. I cannot recognize, here, everyone who helped me to understand conditions in the various countries I visited, but I am especially indebted to certain gentlemen who not only provided information but also made arrangements for me to meet knowledgeable people in their respective countries. In France I received a great deal of help from Mr P. Pietri, Directeur des affaires maritimes en Méditerranée and Mr P.-Y. Dremière of the Institut des pêches maritimes at Sète. My review of arrangements in Greece owes much to assistance I received in Athens from Mr D. Kostakopulos and Mr A. Laggis.

In Italy Mr De Leon, Direttore Generale of the Direzione Generale della Pesca Marittima, and Mr G. Cingolani, Director of the Ancona Fishermen's Cooperative, were particularly generous with their time and information. In Spain Mr J.M. Masip, Secretary of the Comisión Permanente de Pesca del Mediterráneo, made extensive arrangements for me to meet other informed people and also provided a good deal of data. My information on Tunisia owes a great deal to Mr L.D. Grouze and to Mr M.A. Abdellatif of the Office national des pêches. In Yugoslavia I became particularly indebted to Mr R. Stijelja and his colleagues at the Institute for Oceanography in Split, and to Miss Tamhina of the Department of Fisheries in Zagreb.

My association with FAO has been mainly through Mr Jean-Paul Troadec, who not only attended to my administrative requirements but also gave me a good deal of information and guidance. Finally, I must acknowledge an especially heavy debt to Dr D. Levi of the Laboratorio di Tecnologia della Pesca at Ancona, who assisted me with patience and geniality during my visits to various countries and gave me the benefit of his extensive knowledge and advice in preparing this report.

PART I

REGULATING FISHING EFFORT: ISSUES AND OPTIONS

SCOPE OF THE REPORT

Regulation of fisheries is a vast subject. Fortunately, this report attempts to deal with only certain kinds of regulation, those designed to control fishing effort. Specifically, it is concerned with means of ensuring efficiency in the development of fishing capacity and in its deployment. It therefore leaves aside most of the biological problems involved in managing fish resources, as well as issues of safety, navigation, marketing and product quality control, international conflicts and other matters that occupy much of the literature on fisheries regulation. Management of fishing effort often has implications for these other issues, but it is sufficiently distinct in its purpose and in the instruments of control it calls for to justify separate treatment.

Throughout this report, attention is focused on the primary sector of the fishing industry. The secondary or processing sector may be affected by the size and structure of the harvesting sector, however, and these effects are relevant to the design of policies for regulating fleet development in particular cases. Nevertheless, regulation of fishing effort presents certain general and unique problems which can be examined more or less independently of other industrial policies. Finally, it should be mentioned that issues of international agreements on management and sharing of catches, and the regulation of foreign fleets are not dealt with in this report. Control of foreign fishing effort, particularly, raises many of the same problems as those encountered in regulating domestic fleets, but governmental objectives usually differ in the two cases, and hence the appropriate regulatory mechanisms differ also.

Interest in regulating fishing effort is not new. In the course of this study the author chanced upon an ancient French document that described prohibitions on paired trawling (chalut-boeuf) on the Mediterranean coast in 1725, and restrictions on the use of trawl nets as early as 1681. Indeed, most industrial fishing countries have a long history, revealing mixed success, of measures to control fishing effort.

But the purpose of nearly all of these measures, including that of the early French ordinances, was to protect stocks from overfishing. This is still, indeed it is increasingly an important purpose of regulation. But it is now widely recognized that protection of stocks and yields is only part of a larger problem; even if stocks are well managed, there is a persistent tendency for fisheries to develop too much fishing capacity. As this report explains, excess capacity and other distortions arise from the common property nature of the natural resource base and give rise to a special need for governmental intervention to maintain industrial efficiency.

Excessive fishing capacity, whether or not it threatens the productivity of natural resources, always means that other productive resources (in the form of labour and capital) are wasted. As fish become more valuable, and as technological advances broaden opportunities for profitable fisheries, the potential benefits of effective regulation grow. The task is to design new institutional arrangements that will promote efficient development of commercial fleets in light of the productive capacities of fish stocks.

Such institutional arrangements are the main focus of this study. It draws on the rather extensive literature on this subject that has appeared during the last few years, a selection of which appears as an extended bibliography at the end of this report. But much of this literature has been written by economists and has appeared in professional journals of economics, so that it is unfamiliar or inaccessible to many of those engaged in the business of managing fisheries.

Regulation of the size and structure of commercial fishing fleets thus presents new and often awkward problems for policy makers. First, it is basically an economic problem and therefore calls for some understanding of economic analysis; but it requires also an appreciation of biological problems in fisheries management and of the legal, institutional, and sociological constraints and possibilities in particular countries and regions. This

implies a rather rare breadth of knowledge and sensitivity. Second, controls on fishing effort may conflict with traditions of unrestricted fishing in maritime nations. Those most directly affected do not always recognize the need for such unfamiliar changes and so resist them, even though they may benefit from them in the long run. Third, unless rationalization policies are carefully designed, they may dislocate fishermen with few occupational alternatives. Such problems of economic adjustment are often aggravated by prevailing excess capacity and overfishing in many important fisheries. Finally, experience with such controls is limited to a few initial measures in certain developed countries, so that the most effective and practicable techniques have not been clearly demonstrated. All these problems emphasize the need for careful analysis of alternative approaches to the problem.

This report does not pretend to specify the best regulatory machinery for any particular country. The history, industrial structure, political institutions and social conditions of Mediterranean nations vary so much that no single set of arrangements will be suitable for all; each must adapt its policies to its own circumstances. This study is intended to provide an exposition of the general regulatory problem and of alternative methods of approaching it. While it makes reference to Mediterranean trawl fisheries, it does not analyse the special characteristics and problems of each country; readers should bear in mind that these national peculiarities will nevertheless bear importantly on the design of appropriate policies. The purpose of this report is to improve general understanding and thereby to promote constructive discussion and action on this important issue of fisheries policy in both national and international forums.

RATIONALE FOR REGULATING FISHING EFFORT

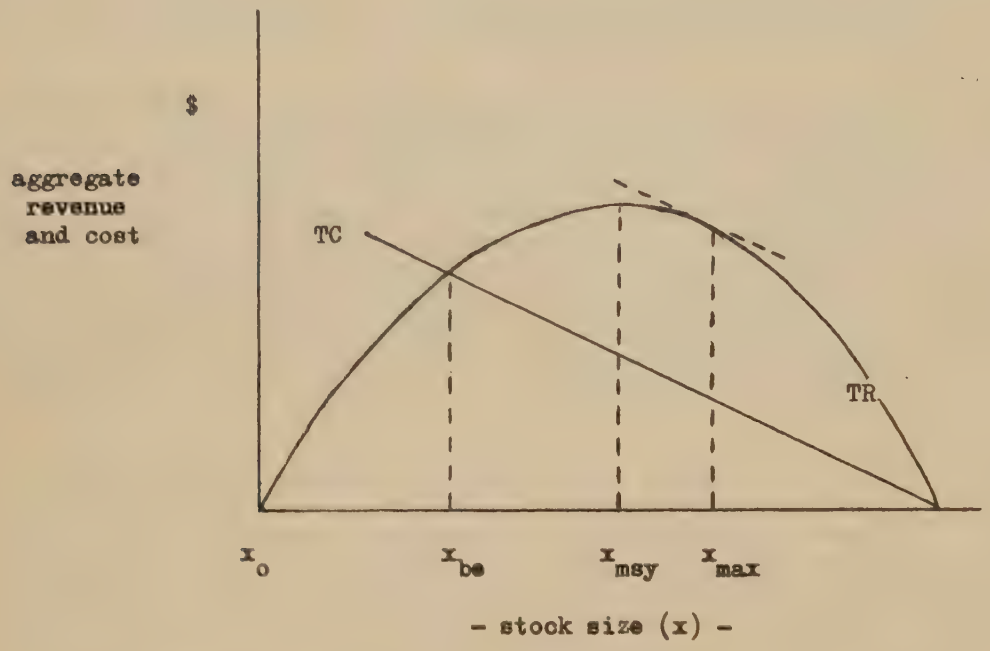
This section deals with the rationale for government intervention to control the expansion and deployment of fishing capacity. The tendency of commercial fishing fleets to expand beyond the level required to harvest the desired catch has been well documented and analysed in recent years. With reference to this extensive literature (listed in the bibliography) the presentation of the problem here is brief. Moreover, by leaving aside much of the esoteric theory expounded elsewhere, attention is focused on the implications for corrective policy measures which are discussed in subsequent sections.

Economically valuable fish stocks are, by definition, capable of yielding harvests of a value greater than the costs of harvesting. This surplus or net value is referred to as resource rent. The potential resource rent varies widely among fisheries. The fundamental economic problem in fisheries management is that wherever there is a large number of independent fishing enterprises exploiting the stock as common property, any resource rent will induce them to expand their fishing capacity, even beyond the level required to efficiently harvest the available catch. The result is that, in the absence of intervention to prevent this tendency, the potential resource rent will, in time, be dissipated through the excessive costs in employing redundant labour and capital in fishing. This wasteful expansion in fishing power may also result in overfishing and resource depletion, unless the catch is controlled by other means.

This process can be explained briefly as follows. Whenever a fishery yields rent, and no agency appropriates this surplus, it will accrue to the fishing enterprises as profits (in excess of the minimum return required to cover the cost of existing capital and entrepreneurship). If access to the fishery is unrestricted, these profits will, in the long run, attract additional entrants to the fishery and induce existing enterprises to expand their fishing power. A profitable fishery is therefore unstable. As the fleet expands, the catch of individual fishing units will decline as larger numbers compete for the yield, especially if the stocks are diminished under the increased fishing pressure. This process will continue until, on the average, the earnings of fishing units are reduced to the minimum required to cover the costs of the labour and capital they employ. At that point, the fishery reaches a state referred to as a bionomic equilibrium, where the value of the sustained catch is no greater than the cost of factors employed to harvest it, and all the potential resource rent is thus dissipated. In the more valuable fisheries, this equilibrium condition is reached only when the stocks are depleted.

It is helpful to illustrate the interrelated biological and economic forces at work in this process with one of the simplest bioeconomic models of fisheries, depicted in the accompanying figure (but readers familiar with this theory, and those who find abstract presentations unhelpful, can safely skip the next few paragraphs). The size of the stock, X, is measured along the horizontal axis in terms of its aggregate weight or biomass. Reflecting the usual logistic model of population growth, the rate of net growth, and hence the sustainable yield of the stock, is a function of the stock size; zero where the stock size is zero, X_0; zero where it is at the maximum size consistent with the productivity and constraints of its natural environment, X_{max}; and greatest at some intermediate stock size, X_{msy}. With a given price of fish, the yield in weight is symmetrical to the yield in value, and thus the yield is shown as a sustainable revenue curve, TR, in the figure. The total cost of fishing effort, TC, required to harvest the sustainable yield is assumed to increase linearly as the stock size decreases.

The bionomic equilibrium is at the stock size X_{be}, where revenue and costs are equal. This is an equilibrium because at any larger stock size revenues will exceed costs and profits will induce expansion of the fleet, while at any smaller stock size the shortfall of revenue relative to costs implies losses which will force exodus from the fishery.



Sustainable costs and yields for an individual fishery

This simple theoretical representation helps to explain the poor economic performance that is observed in nearly all mature, unregulated fisheries. Fishing capacity expands, raising the total cost of labour and capital employed in the fishery, and the catch per unit of effort declines until yields are just sufficient to cover costs. Even potentially rich fisheries, capable of yielding a highly valued catch at low cost, will gravitate toward this bionomic equilibrium in which all resource rents are eroded away and returns to labour and capital are low. Thirty years ago, Michael Graham (1949), one of the first to analyse the problem, called it the Great Law of Fishing, "Fisheries that are unlimited become unprofitable", and twenty years later Garrett Hardin (1968) popularized "the tragedy of the commons". In recent years increasing numbers of fisheries around the world have added support for the theory; although fisheries in an early stage of development may show high returns, or mature fisheries may be highly profitable following new developments in markets or technology, they tend, inexorably, toward this state of economic stagnation.

For the present purposes of this report it is not necessary to examine all the qualifications to this general tendency that may apply in particular fisheries. However, in the context of a discussion about regulatory policies, certain points should be emphasized. First, the bionomic equilibrium cannot normally be regarded as a stable condition, or one to which fisheries can be expected to adjust straightforwardly. The biological response of a stock to fishing pressure is often slow and complicated, and the lags in adjustment of the fleet in response to economic incentives are likely to be different. An expanding fishery might therefore overshoot the bionomic equilibrium, perhaps drastically reducing the stock,

leading to a painful period during which losses are incurred until sufficient capacity is withdrawn, a phenomenon which has frequently been observed (Paterson and Wilen, 1977). Further, it is apparent that the equilibrium will be stable only if the exogenous influences on stocks and yields, and the economic determinants of prices and costs, remain constant. But it is well known that environmental changes, which are often not well understood, cause stocks to fluctuate, sometimes dramatically (Dickie, 1979). Moreover, fish prices and fishing costs often change. If the available catch increases, or if fish prices rise, or if changes in technology or input prices lower fishing costs, the fishery will expand, and vice versa. Because such changes are normal, the bionomic equilibrium should be regarded not as a steady state but as condition around which a fishery is constantly adjusting in short-term disequilibrium, expanding or contracting in response to current profits or losses. Thus policies of economic rationalization are often aimed not only at improving long-run economic performance, but also at alleviating the burdens of adjustment associated with instability.

Second, it should be noted that, although the problem of resource depletion is obviously related to the problem of excess capacity, the equilibrium condition does not necessarily involve "overfishing". In the figure, bionomic equilibrium implies biological overfishing, in the sense that it occurs at a stock size smaller than that capable of the maximum sustainable yield. But this is not necessarily the case. A lower sustainable yield function, or higher costs that would mean a more steeply rising cost curve, could cause the equilibrium to occur at a larger stock size than that associated with the maximum sustainable yield. Thus biological overfishing is most likely to occur, as we observe, in fisheries where the value of the catch is high and the cost of harvesting is low; in other words, where the potential resource rent is great.

Third, the illustration disguises the fact that even if the stock is maintained at a level superior to that of the bionomic equilibrium (through a quota on the catch or other controls) so that the potential cost of taking the regulated harvest is less than the value of the catch, the resulting profits will attract expansion in fishing capacity until costs rise to dissipate the potential net gain. Thus there are many examples of fisheries in which the stocks and yields have been carefully regulated without producing any lasting economic benefit (Crutchfield and Zellner, 1962; Crutchfield and Pontecorvo, 1969).

Most of the literature on the economics of fisheries has been concerned with this pervasive tendency of open-access fisheries to expand redundantly to the point where the aggregate net value of production is reduced to zero, and with policy measures that can forestall this waste. But other economic inefficiencies arise in unregulated fisheries also. One is that too much effort is devoted to the richer stocks and fishing grounds relative to the less productive (Gordon, 1954). Another is distortion of the structure of fishing units because of open competition for the catch: incentives exist, for example, for individual fishermen to increase the speed and holding capacity of their vessels to reduce running time, even if these measures raise costs without increasing the total catch. Moreover, openly competing for the same fish, fishermen are driven to adopt new technology faster than is economically optimal (Scott, 1955).

The tendency toward economic inefficiency in this sense is manifested most conspicuously in excessive expansion of fleet capacity, and the regulatory problem is usually referred to (as it is in this report) as one of controlling capacity or total fishing effort. However, it should be noted that it is more fundamentally a problem of excessive costs, resulting from employment of more labour and capital than is necessary to harvest the catch. Efficiency is thus a measure of the extent to which production is achieved with the minimum cost of inputs that technology permits, thereby maximizing the net economic return.

The fundamental cause of these economic inefficiencies is the common property character of the fish resources. If the fishery were under the control of a sole entrepreneur, he could be expected to manage the yield and to deploy an efficiently organized fleet so as to maximize the fishery's net economic return or rent. In contrast, a large number of independent fishermen with the same profit-maximizing objective, but competing for a common

stock under the rule of capture, cannot be expected to achieve the same result. With no assurance of being able to appropriate the benefits of any individual restraint, and under continuous competition for a share of the catch, each will have incentives to employ more effort as long as it yields a return in excess of the cost. Such inefficient and wasteful use of natural resources, and of labour and capital, tends to occur wherever resources are subject to common property exploitation, and is manifested not only in overcapacity in fishing but also in overgrazing of common pastures and rangelands, overcutting in common forests, overdrilling in oil reservoirs with fragmented extraction rights, and pollution of air and water (Hardin and Baden, 1977). Whenever the social cost of these distortions is large, as it clearly is in many fisheries, there is justification for regulatory policies to mitigate them.

ISSUES IN REGULATING FISHING EFFORT

Before proceeding further, it is important to distinguish several more or less separate regulatory problems which sometimes become confused both in theoretical discussions and in regulatory practice.

1. Regulating the Composition of the Catch

It is now widely recognized that the size or value of the sustainable yield from a given stock often depends upon the selectivity of the gear used and the timing and location of fishing. In unregulated fisheries, fish may be taken that are too small, or fishing in certain locations at certain times may interfere with spawning and recruitment, thereby reducing yields below the level that could be achieved with more discriminating fishing, even with the same amount of effort. Thus regulatory agencies in the Mediterranean and elsewhere have frequently imposed minimum mesh sizes and other controls on gear selectivity, introduced closed seasons and restricted fishing in certain areas to protect and enhance the productivity of the stock.

In terms of the preceding diagrammatic model, these controls influence the shape of the sustainable yield curve: indeed, for any fishery, each combination of such regulations implies a different yield curve (Beverton and Holt, 1957). Effective controls of this type, by altering the composition of the catch, result in higher yields from any stock size or under any sustained level of fishing effort. Their impact on fishing costs varies, but they are economically advantageous whenever the resulting increase in the value of the yield exceeds the private and administrative costs of imposing them.

Appropriate regulations to protect or enhance the productivity of stocks must be designed in light of the biological characteristics of each species and of the technology employed in each fishery. These problems are beyond the scope of this report. But it is important to distinguish these regulations, the purpose of which is to improve the form of fishing effort, from those aimed at controlling the amount of effort, which is the main concern here (Crutchfield, 1979).

2. Regulating the Size of the Catch

A second regulatory problem is that of selecting the appropriate level of catch. Traditionally, regulatory authorities have sought to achieve the maximum sustainable physical yield, which implies a stock size X_{msy} in the figure. However, some recent biological studies have suggested that for species subject to wide natural fluctuations greater stability in stocks and yields can be achieved by harvesting less (Sissenwine, 1978), and others have concluded that long-term yields can be increased if the catch is adjusted upward and downward according to the current condition of such stocks (Walters, 1979).

Economists, concerned more with social values than with biological capabilities, have favoured the goal of maximizing the net economic yield. This implies a larger stock, X_r, where the surplus of revenues over costs (or resource rents) is greatest. Some recent economic analyses have modified this static rent maximizing optimum by demonstrating the dynamic path of stock adjustment required to maximize the net present worth of harvests over time (Clark, 1976). Authorities in Canada and the United States have officially adopted an objective of "optimum yield" which, although it has not been rigorously defined, is clearly intended to take account of economic as well as biological factors (Larkin, 1977).

Determination of the desired level of catch is obviously an important concern of fisheries managers, but analysis of the various principles they might follow is also beyond the scope of this report. For present purposes, it will be assumed that regulatory agencies have clear criteria for determining the desired levels of harvests, and that they will thereby identify them with whatever precision their data permit.

Thus, while the problem of protecting the productivity of stocks is one of selecting and adhering to the appropriate sustainable yield curve, that of regulating yields involves selecting the desired point on the yield curve. This is basically an issue of allocating yields over time. Once the desired harvest level is thus identified, the regulatory problem is mainly one of constraining harvests to this limit, which can be accomplished by restricting the capacity of the fleet, regulating its effective fishing effort, or by means of a variety of other controls discussed below.

3. Maintaining Efficiency in the Fishing Process

A third problem is that of achieving and maintaining industrial efficiency in fishing (which relates to the cost function in the model). This issue is in large part separate from that of determining yield targets because, as already noted, fleets will tend to expand beyond the capacity needed to efficiently harvest the catch even if the allowable catch is carefully controlled.

The problem of overexpansion is often seen as one of too many vessels. But too many vessels (or too much "capacity", or engine power, etc.) is only the superficial manifestation of the more fundamental economic problem of excessive employment of labour and capital, and therefore excessively high costs of fishing.

> "... there is an even more fundamental problem: the ultimate source of economic waste in commercial fisheries is neither excessive numbers of vessels nor excess capacity per se, but rather the use of too many inputs - labour and capital. Thus it is in terms of reduction in the real costs associated with redundant inputs (however, they may be combined in fishing units) that the success of a program of economic rationalization must ultimately be measured." (Pearse and Wilen, 1979, p. 765).

The solution to this problem thus involves preventing, or at least mitigating, the tendencies toward unnecessarily high costs that result from excessive expansion of the fleet and wasteful distortions in technology and in fleet deployment referred to earlier. Ensuring efficiency in this sense is critical in determining the economic and social performance of fisheries, and is the central issue of this report.

4. Other Problems

There are other regulatory problems in managing primary fishing industries, most of which are related to one or more of those above. As already mentioned, industrial efficiency involves not only ensuring an appropriate level and type of total effort, but also ensuring an efficient distribution of the total effort between stocks and fishing grounds. There may also be a need for intervention to protect product quality, to improve working conditions, to prevent monopolistic practices, and for other purposes which are of secondary relevance to this report (Scott, 1979).

It is useful to distinguish these regulatory problems in this way because, although they are not entirely independent of each other, they can usually be dealt with most effectively by using different instruments of control. Certainly, controls can be effectively designed only with a clear recognition of the problems they are meant to solve. Yet, as we shall note below, the history of fishing regulation provides many examples of measures that are suitable for dealing with one problem having been extended in attempts to solve another, with unfortunate consequences.

Much of the literature on the economics of fisheries regulation links the problems of achieving the desired catch with that of achieving efficiency in harvesting. It is assumed that both the selectivity of gear (underlying the yield curve) and the technology of fishing (underlying the cost curve) are fixed. Then alternative regulatory measures are examined with respect to their capability of bringing about the desired adjustments in both

resource yields and industrial organization. Thus, for example, a suitable tax on the catch would lower the curve of total revenue to the fleet, and shift the equilibrium to a superior point with a larger stock size and lower fishing costs; or a tax on gear would raise the cost function, again achieving both the desired yield and cost level. From a theoretical point of view this is appropriate, because determination of the optimum yield is not independent of the cost of fishing.

For present purposes, however, it is helpful to distinguish these regulatory tasks more clearly. In the following discussion, the largely technical issue of controls to ensure the productivity of the stock (selective gear and so on) will not be examined further. Moreover, consistent with usual practice, it will be assumed that the regulatory authority determines separately the question of allowable catch, using whatever criteria and with whatever degree of precision are appropriate in each case. The rule adopted may be the maximum sustainable yield, some more sophisticated criteria based on costs and values, a special target that takes account of the complexities of interdependence of mixed stocks, or some fraction of a total allowable catch calculated and allocated by an international agency. The following discussion will not deal further with the choice of yield criteria, although it will be concerned with the efficient realization of the yield objective. In short, under the assumption that the yield target is separately specified, embodying any trends or seasonal variance that may be called for, attention is focused on the issue of maintaining an efficient fleet capacity and achieving a high level of industrial performance in harvesting the available catch.

CRITERIA FOR EVALUATING RATIONALIZATION MEASURES

In turning to policies for improving the economic performance of commercial fisheries, attention should be directed briefly to the mixture of regulatory objectives or criteria that are likely to be relevant in selecting among alternative approaches. These provide a framework for evaluating different methods of control. The relative importance of particular objectives varies, of course, among governments and fisheries, but some combination of the following list of considerations is likely to motivate, and constrain, policy makers in most cases (Troadec, 1978).

a) Effectiveness in Controlling Fleet Capacity

This issue is central to any programme of economic rationalization: to prevent the expansion of fishing capacity beyond that required to efficiently harvest the desired catch. More precisely, this concern is to prevent redundant labour and capital from being attracted into the fishery, thereby raising costs, lowering net returns, and creating a threat of overfishing, as described above. Thus the main criterion by which rationalization policies must be judged is their ability to maintain fleets at an efficient capacity in light of the desired level of catches.

b) Implications for Technological Efficiency

Closely related to the concern with fishing capacity is the need to ensure that fishing units will employ efficient technology in both the technical and economic senses, avoiding the distortions mentioned earlier. Moreover, as we shall see, some approaches to regulation are likely to impede adoption of efficient new technology. The desirability of controls that will encourage the use of appropriate technology in fishing is thus an important consideration.

c) Adaptability to Changing Conditions

The circumstances of fisheries constantly change. Stocks fluctuate in abundance, new technology appears, costs and prices rise and fall, and the general economic and social environment that governs markets, labour supplies and other conditions shifts in uncertain patterns. Such changes can be accommodated by certain forms of regulation, while other forms lose their effectiveness and require governmental intervention to restore their regulatory power. For reasons relating to uncertainty, administrative costs and the dangers of inaction, the types of regulation that depend on recurrent discretionary action on the part of the authorities are usually regarded as inferior to those that can accommodate change. Responsiveness and adaptability to change are thus very important qualities governing the choice of rationalization measures.

d) Effect on Distribution of Effort

In addition to the problem of maintaining an appropriate total amount of fishing capacity is the separate issue of ensuring its efficient deployment over the stocks and grounds accessible to the fleet. The extent to which any regulatory measures will encourage, or enable the regulatory authorities to enforce efficient distribution of effort is therefore likely to be a more or less important consideration in evaluating control measures.

e) Distribution of the Benefits

If the measures produce economic gains, who will receive these benefits becomes an important question. Certain ways of introducing restricted entry, for example, confer windfall gains on existing fishermen and prejudice the opportunities of potential fishermen; some licensing arrangements effectively provide capital gains to vessel owners, or to fishermen; others ensure that the benefits accrue to the government through tax revenues or fees,

and so on. Concern for improving fishermen's incomes is often dominant, but not all techniques will promote this. This issue of the distribution of economic benefits has been a major preoccupation of governments in designing regulatory schemes (Scott, 1979).

f) Dislocation and Employment Effects

An efficient industrial organization of a fishery implies a particular combination of factors of production, collectively referred to as labour and capital, in the light of their cost and the technology available. But governments usually have a separate concern about employment, often regional employment, and they may be prepared to compromise economic efficiency in order to ensure more employment opportunities. This concern is usually for employment of labour rather than capital, but fishing technology typically admits a degree of substitutability between labour and capital, and a government may prefer one regulatory measure over another if it will promote more labour-intensive operations, for example.

A somewhat separate issue is the amount of sudden change, or dislocation, that would result from introducing a rationalization policy. This is largely a transitional issue; it depends on how much overcapacity and other distortions exist to begin with, and how fast the rationalization process is pressed. But beyond this, some measures can accommodate established enterprises more than others, and introduce less uncertainty. Industrial and regional stability is an increasingly important concern of governments, and in any event it is usually difficult to introduce changes that threaten to disturb established interests. They are therefore likely to shun policy innovations that cause significant dislocation.

g) Administrative Complexity and Cost

Finally, governments must be concerned to design policies that are capable of being effectively administered and enforced at reasonable cost. Rationalization measures vary enormously in their requirements for information, analysis, communication with private interests, and means to ensure compliance. They vary, too, in the burdens of administration and compliance that they impose on the regulated parties. Governments differ, of course, in their administrative capabilities, but in general they can be expected to favour regulatory measures that entail lighter administrative burdens.

A government's influence on fishery development is seldom through a single agency. The decisions of departments or ministries concerned with such diverse issues as international trade, political relations with neighbouring coastal states, taxation policy, and the allocation of oil supplies can have a significant impact on fishing industries and, unless their actions are well coordinated, may frustrate the policies of fisheries authorities. This danger is especially serious when governments are forced to adjust to sudden political or economic dislocations. Rationalization policies are thus likely to be more effective if they are not only simple but also robust enough to withstand change and crisis in the social and economic environment within which the fishing industries operate.

There may be other concerns of regulatory authorities in particular cases, but these are those which appear to have been uppermost in designing programmes of rationalization hitherto. They are not entirely complementary, and so compromises among them, which involve political judgement, are sometimes required. But the conflicts should not be exaggerated; there is no incompatability, for example, between the goals of achieving the desired yield, maintaining the appropriate fleet capacity, and of ensuring efficiency in technology and in the distribution of effort. Nor (depending upon the type of controls used) do these necessarily conflict with the aims of improving income levels and administrative simplicity. Typically, the most awkward issues relate to the implications of rationalization programmes for labour employment. The greater the excess labour already involved in the fishery, the fewer the alternative opportunities for regional employment, and the faster the rationalization programme is implemented, the more serious will be the problem of employment adjustment. But, as we shall see, there are ways of mitigating these difficulties without abandoning the gains to be realized through rationalization.

The problems associated with adjusting a commercial fleet to the desired size and structure are obviously much less difficult where fisheries are in an early stage of development and reduction of the fleet's capacity is not necessary. In mature fisheries, labour force adjustment presents more awkward problems because too much manpower has already become dependent on fishing, and often because uncontrolled expansion in fishing capacity has reduced available catches to the extent that they can no longer sustain so much employment. The policy question is whether, or for how long, it is advantageous to maintain this surplus labour in fishing. Although modern governments typically accept some responsibility for provision of employment opportunities, overcrowded fisheries will rarely afford the most economical or effective industry in which to provide them. In the long run, other sectors are likely to be less costly in terms of the capital required per person employed, and the depressing effect on the incomes of others. As critics of fisheries policies have frequently emphasized, it is illogical to put the burden of unemployment on the fisheries; employment policy, if it is to be effective, must take a broader view, providing expanded opportunities in various sectors in light of costs and potential contributions to aggregate production (Crutchfield, 1979). The appropriate distribution of the labour force will, of course, constantly change, and this calls for policies that will ease and facilitate, rather than impede, these economic adjustments.

APPROACHES TO FISHERIES RATIONALIZATION: THE MAIN ALTERNATIVES

Having identified the problems to be dealt with, and the main criteria for assessing control measures, we now turn to examine the alternative approaches to fisheries rationalization. Economic control measures have been suggested, and attempted, in considerable variety, but they can be classified, according to their basic form, into a few categories, viz:

1. Restrictions on gear, closed seasons, and closed areas
2. Direct restrictions on vessels
3. Taxation of vessels or equipment
4. Taxes or royalties on the catch
5. Quantitative rights

Each of these is examined below, with reference to the criteria noted earlier.

It should be noted that there are other solutions to this problem which are not examined here because they are generally inapplicable to the kind of fisheries of main interest in this report. For example, shellfish and other sessile species lend themselves to exclusive rights over prescribed areas; this eliminates the common property problem altogether, and allows individual holders of such rights to harvest and manage the resources efficiently. Similarly, exclusive area rights on lakes, lagoons, and parts of rivers are sometimes used effectively to regulate exploitation of free swimming fish where their migration between areas is limited.

The common-property problem might be eliminated even in the case of a free swimming marine stock by granting exclusive rights to the whole fishery to a single private enterprise, although examples of this arrangement are rare. The same result can be achieved where all fishing is organized by a state agency, as in some centrally planned countries. Indeed, there is a state fishing sector in some of the Mediterranean countries examined in this report, in these cases it operates alongside an independent private sector. The approaches to regulation discussed below are those suitable for fisheries based on free swimming ocean stocks which are exploited, at least in part, by a number of independent fishing enterprises motivated by financial returns.

1. Restrictions on Gear, Closed Seasons and Closed Areas

Restrictions on gear and on the time or location of fishing can, as noted above, serve a useful purpose in increasing yields by affecting the composition or quality of the catch. As means of controlling the total catch or the total fishing effort, however, they are generally ineffective in the long run and may worsen economic performance. Such restrictions have nevertheless often been imposed for these latter purposes, and so their implications deserve comment here.

Restrictions on gear that serve no purpose in affecting the composition of the catch, but are intended to protect stocks from excessive fishing, are numerous and varied. Familiar examples in Mediterranean countries include restrictions on the length of nets and the number of hooks on lines, limitations on the power of motors and prohibitions on pelagic trawls. From an economic point of view, all these measures simply restrict efficient fishing and thereby raise costs. The result is that more labour and capital are employed in fishing than existing technology requires, the economy as a whole sacrifices other goods and services that could be produced by these factors of production wastefully employed in fishing, and the fishery fails to yield its potential net benefits. Far from curtailing effort, these restrictions reduce the efficiency of effort so that more effort is necessary to harvest a given catch. They therefore do nothing to generate rent; on the contrary, they simply move the fishery to a new equilibrium at which costs are higher.

Gear restrictions have usually been imposed to protect stocks from excessive fishing where the authorities lack more suitable means for controlling effort. While they can thus be used to reduce fishing power, they do so by lowering production efficiency, and conservation of fish is thus accomplished only at the expense of other resources wasted in the fishing process (Crutchfield, 1965).

Seasonal closures, area closures and total catch quotas are also sometimes used as administratively easy means of preventing excessive pressure on fish stocks. But again, in the long run the fishery will tend to adjust to these restrictions and erode any short-run gains.

Closed seasons, for example, simply reduce the time in which the fish may be taken, without affecting a long-run reduction of effort. For the individual enterprise, fishing during the shorter season will become more urgent, and this will encourage distortions in the design of fishing units by providing incentives for increased speed and storage capacity. Any short-run increase in profitability will attract additional entrants. As the fishery adjusts to the shorter season, the season will have to be progressively shortened in order to prevent total pressure from increasing. If the fish are equally available during the closed and open seasons, this process will result in no reduction in excess fishing capacity; on the contrary, the fleet will expand to a size capable of taking the catch in a shorter season. Additional inefficiencies will result from the stronger pressures on vessel owners to minimize their travel time and layover at ports, and to land their fish at the closest port. At the ports, the harvest will be received during a short period, increasing the costs of handling, storage and processing. The market, too, will have to adjust to the short harvest season, increasing the costs of storage and marketing, and perhaps changing the nature of the product (i.e., from a fresh to a preserved product). Finally, unless they have access to other fisheries, fishermen and vessels will be unemployed during the closed season. In short, seasonal closures, like gear restrictions, are ineffective means of regulating fishing effort; indeed, they aggravate structural distortions and inefficiencies in a fishery, thereby raising costs unnecessarily.

One qualification to this conclusion should be noted (in addition to the reminder that seasonal closures may be usefully employed to protect spawning or immature fish). As in the case of certain Mediterranean fisheries to be described later, daily, weekly or seasonal closures may be advantageous in improving working conditions in fisheries in a way that could not be accomplished without collective action. For this purpose, closures have a limited scope, however. The general conclusions above hold whenever closures impose involuntary unemployment of the fleet.

Area closures, used to prevent overexploitation, also induce inefficient distortions. If the stocks are mobile between closed and open areas, the fishing will simply be less efficient, because it will require more effort to take a given catch in the constrained area. If they are not mobile and the closure is permanent, the potential yield of the enclosed stock is simply eliminated. If the closure is seasonal, it has the same economic effects as a closed season.

The economic effects of a total catch quota are similar to those of a closed season. Under a quota, fulfilment of the allowable catch automatically closes the season; an open season reflects the administrator's calculation of the time it will take for the fleet to harvest the desired catch. In either case, the individual fisherman is under pressure to rush to the fishing grounds with all the gear he can muster, and to minimize the running time in order to catch as much fish as possible before the aggregate quota is reached or before the season is closed. Economic inefficiency will again result from increased handling and storage costs at ports, distortions of the geographic pattern of fishing and of landing fish, possibly uneconomic use of collecting boats and factory ships, and increased preservation and marketing costs. Determination of the appropriate level of catch is, as explained earlier, an important task of regulatory authorities, but it does not, in itself, afford a satisfactory means of regulating total fishing effort.

Various combinations of closed season, closed areas and quotas are possible, of course, and a wide variety of such controls can be found among Mediterranean fisheries (FAO, 1973). Most of the distortions noted above have been illustrated dramatically in the Pacific halibut fishery in its history of frustrated attempts to control fishing pressure by these methods (Crutchfield and Zellner, 1962). In reference to this fishery, James Crutchfield has written:

> "We can, as in the case of halibut, establish a quota, presumably at a level that approximates maximum sustained yield, and impose no other restriction of fishing effort. If only the minimum necessary number of vessels required to catch that amount of halibut were employed, a very considerable margin over and above minimum costs would be realized by the fleet. As could easily have been predicted, the rebuilding of the halibut population led to a 300 percent increase in the number of boats participating in the fishery. But as the number of boats increased, each boat faced higher and higher operating costs per unit of catch. Again, the end result was to increase costs until only minimum necessary returns could be earned. Something fairly close to the proper catch is now being taken, but with two or three times the number of fishing units actually required." (Crutchfield, 1965 p. 12).

These results, and the associated increases in the costs of processing, distributing and marketing halibut, led Crutchfield to conclude:

> "The halibut programme has been a conspicuous success - from a biological standpoint. ... the conservation authority is not inept, nor has it been unaware of these economic problems. Indeed, many of them were forecast years ago by members of the Halibut Commission staff. What is involved is not a failure of performance but a mistaken concept as to what is to be conserved and what is to be maximized." (Ibid, p. 13).

In short, none of these traditional controls - gear restrictions, seasonal closures, area closures or total catch quotas - can, by themselves, have any lasting beneficial effect on the economic performance of fisheries. While they may have a place in protecting the stock from destructive forms of effort, they are ineffective as means of controlling the amount of effort. Indeed, by distorting fishing activity technologically, geographically or seasonally, these measures will tend to aggravate the poor economic performance in fishing and secondary industries; because they fail in this basic criterion, it is not worthwhile to examine them further in terms of the other criteria noted earlier. The approaches to rationalization discussed below offer more promise as means of controlling fishing effort in ways that improve the industry's economic performance.

2. Direct Restrictions on Vessels

Almost all of the recent attempts to control expansion of fishing capacity involve regulating access through some form of restrictive licensing. In recent years this approach has been adopted widely: nearly all the major fisheries of Canada and several of those in the United States have been subjected to restricted access during the last few years, and examples are found also in certain European countries, Australia, Japan, South Africa and an increasing number of other countries (McKeller, 1977). Licensing arrangements are also being developed by coastal states to regulate foreign fishing in their extended fisheries jurisdictions (Kaczynski, 1979).

To provide an administrative basis for this kind of control, a licence or permit must be devised to convey the restricted right to fish. Moreover, the licence must specifically convey a right to engage some input in fishing; most often it authorizes to engage a vessel, but there are examples of licensing that provide the right to employ a specified number of tons of vessel capacity, a specified unit of gear, or fishing privileges to specified persons (McKeller, 1977). Various combinations of inputs can also be licensed, but it is the necessity of selecting some particular input or inputs as the basis for restrictive licensing that gives rise to the most serious difficulties with this method.

The importance of this issue derives from the fact that, in most fisheries, the technology of fishing is flexible. In economic terms, the factors of production are substitutable and can be combined in widely varying proportions and configurations, so that restriction of one or two dimensions of fishing power will lead to more intensive use of others. Thus if fishermen are limited by fishermen's licences, and the programme is successful in raising profits, strong incentives will arise for the licensed fishermen to equip themselves with larger vessels and more gear to increase their catching power; or if vessels are the restricted factor, incentives will exist to increase their size and catching power, and so on.

Because of this flexibility in fishing technology, both theory and experience suggest that restrictions on one or a few factors of production are not likely to succeed, in the long run, in preventing expansion of fishing capacity. In Canada's Pacific salmon fishery, for example, the initial licensing of vessels led to replacements with much larger vessels, so that addition of redundant capital continued. In an effort to control this, licences were changed to limit the net tonnage of vessels, but investment in new gear and vessel improvements continued (Fraser, 1979). After more than a decade of this ambitious rationalization programme, the structure of the fleet has changed significantly and the number of vessels declined, but the capital employed in vessels and gear has increased nearly threefold. Moreover, in view of technological improvement, the fishing power of the fleet, already far in excess of requirements when the programme was introduced, has increased even more (Pearse and Wilen, 1979). Similarly, restriction of the tonnage of licensed vessels in the Japanese tuna fleet led to reconstruction of vessels to increase their catching power within their permitted tonnage (Keen, 1973). Limitation of the number of vessels in the Western Australian rock lobster fishery was followed by a marked expansion in the size of vessels (Meany, 1979). Restrictions on engine power in France's Mediterranean trawl fleet led to expansion of other dimensions of fishing power, including traction (Dremière, 1974). Nevertheless, where licences have been used to restrict access to a fishery, they have typically taken on a market value, suggesting that some resource rents have emerged, or at least are expected to emerge.

Theoretically, it is possible to design a licence that would restrict all dimensions of fishing effort simultaneously; but these are so numerous and diverse (involving vessel size, power, crew, time spent fishing, all aspects of finding, catching and holding gear and so on) that to do so would be extremely costly. To effectively regulate all, or sufficient, key dimensions to prevent substantial erosion of rents through additions to those that remain unrestricted, and especially to enforce the controls, would undoubtedly be beyond the capabilities of most regulatory agencies. It would obviously impede technological advance, as well. Not surprisingly, no government has attempted to regulate more than a few dimensions of effort.

The extent to which the potential gains from restricting certain factors will be dissipated in expanded use of others, and the rapidity with which adjustments will occur, will depend upon the flexibility of technology in particular fisheries and the factors selected for restriction. Semi-industrial fisheries, for example, are probably more amenable to flexible alteration of technology than are either large distant water fleets or artisanal fisheries, and limitation of the number of pots in a lobster fishery may be more effective than limiting the size of vessels in a trawl fleet. However, the available evidence suggests that, in semi-industrial fisheries at least, the technology of fishing is so flexible that limitations on one or two elements of fleet capacity will be insufficient to prevent expansion of other, unrestricted, factors. While many regulatory authorities have undoubtedly been attracted by the administrative simplicity of rudimentary controls of this kind, dependence on them, alone, will likely necessitate restrictions on an ever-increasing number and variety of factors, with uncertain results in the long run. Certainly, restrictions of this kind do nothing to eliminate incentives to expand fishing power redundantly - indeed, if they succeed in generating profits the incentives to increase capacity will be strengthened - and this must be regarded as a serious threat to any rationalization programme based entirely on restrictive licensing.

An FAO committee, in a recent review of arrangements for regulating trawl fleets in the Mediterranean, reached similar conclusions.

> "Limitation of the number, tonnage and engine power of trawlers is not usually sufficient to block the fishing effort permanently. In effect, the fishing power of a trawler depends, not only on the conduct and distribution of fishing operations, but also on a great many other factors (traction power, plan and rigging of the trawl, equipment for navigation and fish detection, etc.). ... in practice, it seems unrealistic to attempt to establish clauses covering all the procedures to which one may resort in order to improve the performance of a vessel. Moreover, this would prevent advantage being taken of the gains in productivity to be expected from technological advances." (FAO, 1978b, p. 25).

However, as will be explained later, restrictive licensing may often be a useful first step in a broader rationalization programme that will ultimately be more effective in containing wasteful expansion.

Restrictive licensing raises certain other problems that have occupied much of the attention of regulatory authorities where this approach has been adopted. One is the method of selecting the initial licensees. There is little to be said in favour of any method based on chance, such as drawing lots. This would fail to discriminate among applicants according to any criterion except luck, and would involuntarily idle fishing units that do not win licences. An auction of licences affords an arms-length method which has the economic attraction of providing some assurance that the most efficient units would obtain the limited rights. It also permits the regulatory authority to appropriate the value of the limited rights to fish. Obviously other, non-pricing methods of selecting a restricted number of licensees could be employed. However, wherever licensing has been adopted, all those who have been active participants in the fishery have been eligible for initial licences, granted without charge or for only a nominal fee. This is not surprising, because only this method avoids any dislocation; but it does not, of course, offer a means of reducing or otherwise manipulating the fleet.

A related question is whether the licences are to be transferable. If they are transferable, the method chosen for allocating them in the first place will be of no lasting consequence: a private market in licences will develop (as can be observed in jurisdictions that have adopted this approach) and they will be reallocated to those who are willing to pay most for them. Attempts to prohibit transferability have proven very difficult, or ineffective. Unless they are buttressed by rigorous controls, they can usually be circumvented by transactions in the equity of companies established to hold the licensed fishing unit. And if he does not have the freedom to sell his fishing right, a holder will find his valuable assets worthless if he retires or dies. In any event, transfers of fishing rights serve a useful economic purpose in promoting their redistribution among those who can exercise them most efficiently and who therefore bid the highest price for them.

The term or duration of licences, must also be decided. If they are unlimited in term, and transferable, continuing market reallocations offer a mechanism for perpetuating the fishery. If they are limited in term, provisions must be made for replacing them through sale of new licences or by some other allocation process. It should be noted that a limited term, combined with any possibility of non-renewal, may threaten to disrupt employment stability and orderly investment planning.

Typically, fisheries to be subject to restrictive licensing already suffer overcapacity, and regulatory authorities need some mechanism for reducing fleet size. A popular proposal for effecting fleet contraction without dislocating established fishermen involves granting all of them lifetime, non-transferable licences and closing the fishery to new entrants. This is the so-called "grandfather scheme". As in a tontine, death and retirement would diminish the number of active fishermen over time, and the returns to each would increase until the fishery was reduced to a few old and wealthy fishermen. Alternatively such licences would be issued to established vessels. In either case, in addition to the

incentives to increase other inputs discussed above, such schemes would discourage retirement of the licenced factor and the rate of egress from the fishery would be beyond external control. In any event, grandfather schemes are only transitional arrangements; sooner or later licences would have to be replaced.

If licences are transferable, the market for licences affords a mechanism for adjusting the fleet size. The regulatory authority can enter the market to "buy and retire" licences or licensed fishing units, as has been done in Canada's Pacific salmon fleet (Fraser, 1979). Moreover, by standing ready to enter the market as either a buyer or seller of licences, the authority can adjust the fleet continuously to meet changing requirements, without causing any involuntary dislocation of fishermen.

Another issue is that of charges for fishing licences, which affects the division of any gains from rationalization between the licence holders and the government. If licences are issued without charge, all the gains will accrue to the recipients, to be realized as higher earnings as long as they remain active, or as capital gains on licence values if the rights are transferable. At the other extreme, if licences were issued by sale at their competitive market value, the licensing authority would capture the resource rents. Obviously, other arrangements such as annual fees are capable of dividing the gains. Whether it is desirable that licensees, rather than the state or others, should garner the benefits from economic rationalization is a political question. But one further observation should be made: certain kinds of levies will alleviate the pressures to distort fishing technology where certain factors are restricted. A lump sum charge for a licence, or a fixed annual fee, will not: because the licensee will find that he will earn maximum returns in exactly the same way with or without it. In contrast, a levy on the catch (discussed below) will reduce his returns from the fish he catches, and so blunt incentives to expand fishing power by adding unrestricted factors. Thus, while any levies can effect a redistribution of resource rents to the regulating authority, some will also serve a useful purpose in promoting the rationalization process.

Finally, note should be taken of two potential problems where restrictive licensing is adopted in complicated fisheries. First, while transferability of licences can serve a useful role in promoting their efficient distribution and redistribution, distortions may arise if the fishery involves more than one type of gear or if fishing units vary significantly with respect to the productivity of the licensed factor. The market will generate a single price for licences, which will reflect the value of the right to fish with whichever type of fishing unit can earn the highest return on the restricted factor. Other types of fishing units might thus be gradually eliminated, even though they may be able to harvest at lower cost, or despite the possibility that the fishery is most efficiently composed of a variety of gear types. For example, under restricted aggregate tonnage in Canada's Pacific salmon fishery, there has been a gradual increase in large seine vessels and decline in other gear types. It has been suggested that this may be because additional tons increase the fishing power of seiners more than of gillnet and troll vessels, but that these induced shifts in fleet structure do not necessarily improve its total efficiency (Pearse and Wilen, 1979). This kind of technological distortion arises from the artificial scarcity (and high cost) of certain inputs because of their restriction. It may call for several types of licences for a single fishery, but to determine the optimal balance among them would present a formidable analytical task.

Second, somewhat related difficulties arise where the relevant fishing units participate in other fisheries, or catch varying proportions of mixed species. In this case, independent regulation of each fishery, even if it assures that the limited rights will be allocated to the most efficient units in each considered independently, will not assure the most efficient overall structure for the combined fisheries. Unless they are sensitively designed, restrictive licensing systems are likely to obstruct participation in multiple fisheries and the use of combination vessels which, in many cases, would be economically advantageous. This is another problem that will be alleviated somewhat if licences are freely transferable.

This discussion can now be summarized in terms of the criteria enumerated in the preceding section.

a) Effectiveness in Controlling Fleet Capacity

With respect to this central issue, it must be concluded that any rationalization scheme based solely on restricting one or two dimensions of fishing power will not be sufficient, in the long run, to prevent at least some expansion of capacity through increases in unrestricted dimensions. The degree of success will vary, depending upon the factors selected for restriction and the technological flexibility of individual fisheries which allows other factors to be used more intensively.

b) Implications for Technological Efficiency

Restrictions on certain inputs will almost certainly induce technological distortions by providing incentives for more intensive use of other inputs. The tendencies to adopt certain kinds of wasteful "competitive" technologies associated with unregulated fisheries (fast vessels, increased holding capacity, etc.) will remain, as will the incentives to competitively adopt new innovations in fishing power too quickly. Restrictions on certain factors of production will also inhibit advantageous technological improvements.

c) Adaptability to Changing Conditions

Adjustments required to accommodate changing conditions, in the forms of fluctuations in stocks, shifts in prices and costs, or new technology are not facilitated by restrictions on inputs, although purchases and sales of licences can provide a mechanism for manipulating fleet size over a longer term.

d) Effect on Distribution of Effort

This approach does not provide an automatic mechanism for manipulating the deployment of effort among different stocks and fishing grounds, unless separate licensing arrangements are provided for each. Otherwise, the need for supplementary controls to regulate the distribution of effort will be the same as in unregulated fisheries.

e) Distribution of the Benefits

The distribution of any economic gains from the restrictions will depend on the appurtenancy of the licences and any charges levied under them. If vessel licences are issued without charge, the gains will accrue to the vessel owners as capital gains; if it is fishermen that are licensed, they will be the beneficiaries. The form of payment to crews, whether a fixed salary or a vessel share, may affect the distribution of private gains between owners and fishermen. If licences are sold at competitive market prices, the regulatory agency will capture the benefits, and various combinations of licence fees, annual charges and royalties on landings can be employed to divide the benefits between the government and the participants in the fishery.

f) Dislocation and Employment Effects

The extent of dislocation will depend upon the initial degree of overcapacity and the manner in which the controls are introduced. If all established fishing units are given privileges, and reduction in capacity is effected either through normal retirement or through a "buy and retire" programme, no involuntary dislocation need occur. The ultimate effect on employment will depend on the amount of capacity reduction required, but it should be noted also that the technological distortions induced by restricting certain inputs are likely to affect the balance between labour and capital used in the fishing process.

g) Administrative Complexity and Cost

The simplest forms of restrictive licensing, such as the licensing of vessels, entail relatively low costs of administration and enforcement. However, if a high level of economic performance is sought, complete reliance on this approach will typically require a much more complicated programme of controls on the components of fishing effort, with concomitantly higher costs of information, analysis of production technology, administration and enforcement.

3. Taxation of Vessels or Equipment

Some economists have suggested that, instead of direct limitation of inputs through restrictive licensing, the same result could be achieved by taxing the inputs (Smith, 1969; Scott and Southey, 1970). This alternative requires only brief examination here, because its implications for effective rationalization are for the most part similar to those described in the preceding section.

Again, if fishing "effort" provided an identifiable and unalterable tax base, a tax on effort could be raised to drive out surplus capacity until only the desired amount of effort could be sustained. But because effort is in reality an evasive and multi-dimensional concept, some more tangible factor of production would have to be selected as the tax base. If this were done, the effects would be largely the same as direct restrictions on those inputs.

There are two important differences, however. First, if taxation of inputs were the mechanism for controlling capacity, all the economic gains would accrue to the taxing authority; there could be no improvement in the incomes or wealth of fishermen. Indeed, if reductions were necessary, the tax would have to be high enough to force exodus from the fishery through financial deterioration in fishing, which is likely to result in painful dislocation. Because dependence on such taxes to constrain fishing capacity thus precludes any advantage to fishermen or vessel owners, this method is not likely to be readily accepted, especially for regulating domestic fleets.

Second, this method has the theoretical attraction of providing a ready mechanism for manipulating the distribution of effort among stocks and fishing grounds, and for responding to changing circumstances, through differential rates of tax. However, it is difficult to visualize this flexibility in practice; quite apart from the administrative complexity of determining the appropriate rates for different locations and stocks (especially in mixed fisheries), the rates would have to be adjusted constantly to changes in the availability of fish, harvesting costs, and fish prices. Moreover, even if this problem could be overcome, such changes would introduce additional uncertainty in fishing. Fishermen would inevitably regard differences in the rate of tax as arbitrary, and they would also resist frequent changes; yet any uniform, constant levy would clearly be inadequate in differing and changing conditions.

4. Taxes or Royalties on the Catch

One of the most popular proposals for rationalizing fisheries in the academic literature is to levy a tax or royalty on landings (Anderson, 1977; Bromley and Bishop, 1977; Crutchfield, 1961; McConnell and Norton, 1979; Sinclair, 1978; Scott, 1962). It can be shown that an appropriate tax would reduce the private returns to fishing sufficiently to force the fleet to adopt the most efficient number and scale of fishing units and to operate them at the minimum possible cost.

Such a scheme has a number of attractions. Most importantly, if the tax is imposed vigorously enough, it can effectively reduce and contain fishing effort by rendering it unprofitable to expand, and it will do so without generating any of the tendencies toward

technological distortions associated with restrictive licensing or taxes on particular factors of production. Technically, at least, it is a highly flexible mechanism; by applying differential rates, the pattern of effort can be manipulated among species, stocks and locations. However, this approach has disadvantages as well as attractive features, which can be summarized under the criteria noted earlier.

a) Effectiveness in Controlling Fleet Capacity

Economic analysis leads to the conclusion that a suitable tax or royalty on fish landed can successfully control a fishery at any desired level of capacity short of the level the fleet would reach if uncontrolled, provided that the charge levied is appropriately adjusted as prices and costs change.

b) Implications for Technological Efficiency

A levy on landings will not introduce any new distortions in fishing technology. However, certain inefficiencies that arise from competition among fishing units for the available catch, which are observable in unregulated fisheries, may remain.

c) Adaptability to Changing Conditions

By altering the rate of tax or royalty, the regulatory authority can accommodate changes resulting from fluctuations in stocks, costs and prices. But this requires a high degree of administrative flexibility and responsiveness. Moreover, this method of regulating effort depends critically on sensitive adjustments. To maintain the fleet at a particular level the levy must capture precisely the resource rent; if it takes more, the fleet will contract and if it takes less it will expand. This means that in the face of changing prices, costs and technology the rate will have to be constantly adjusted, and any errors will be manifested in unwanted changes to capacity. Quite apart from its heavy information requirements, this continual "fine tuning" of the rates would almost certainly encounter resistance from fishermen.

d) Effect on Distribution of Effort

Similarly, different rates of royalty on different species, stocks and fishing grounds would influence relative returns to fishermen, suggesting a means of manipulating the distribution of fishing effort (McConnell and Norton, 1979). But again this would call for a degree of flexibility in levying charges that is not often found in regulatory agencies.

e) Distribution of the Benefits

This method requires that the regulatory agency appropriate all the resource rents. It therefore affords no gain to fishermen (unless it were combined with some scheme for transferring income to them in a way that would not affect their behaviour).

f) Dislocation and Employment Effects

The royalty could, of course, be raised gradually to effect the required reduction in the fleet slowly. However, this would prolong the agony, since the incomes of all fishermen must be lowered for as long as exodus from the fleet is required.

g) Administrative Complexity and Cost

The cost of effectively controlling fishing effort through a royalty would almost certainly be high. The need for continual adjustments in rates in response to changes in the availability of stocks, costs and prices would create heavy demands for information and for econometric analysis of fishing costs. An educational effort to persuade fishermen of the logic of the programme and to gain acceptance would almost certainly be necessary also. The cost of collecting the royalty would also be considerable, and would depend upon port

and marketing arrangements. The routine issuance of receipts (or "fishing tickets") upon the sale of fish in port markets is increasingly common, and this affords a mechanism for simplifying the administration of a royalty. In the absence of such established practices, new accounting mechanisms would have to be introduced. Probably most onerous would be the costs of enforcement because of the obvious incentives a royalty would generate for fishermen to avoid reporting their catch.

Three disadvantages of this approach to rationalization seem particularly formidable; its need for continuous and accurate adjustments in the royalty rates; its failure to offer any economic advantage to fishermen; and its high costs of administration and enforcement. Thus, while royalties are a theoretically efficient device for regulating fisheries and have been widely discussed in the academic literature, no government has attempted to regulate fishing effort by this means. (Some countries levy charges on fish landed by foreigners, but these are for revenue purposes; other controls, usually involving licences, provide the main instruments for regulating fishing effort.)

5. Quantitative Rights, or Individual Fishermen's Quotas

During the last couple of years, increasing attention has been directed to the possibility that the objectives of fisheries rationalization would be met if fishing enterprises were provided with rights to harvest specific quantities of fish (Moloney and Pearse, 1979; Pearse, 1979; Christy, 1973; Clark, 1979b; Scott, 1979). Under the simplest form of this system, the regulatory agency would issue rights, not just to engage in fishing, but to take specified quantities of fish. These rights, in the form of licences or permits, would be denominated in small quantities, amounting in total to the allowable catch, and they would be freely transferable.

Regardless of how these rights were initially allocated, individual fishermen would be free to adjust their holdings through purchases or sales to obtain a quantity that their fishing units can harvest most profitably. Indeed, in the long term they can be expected to adjust their vessels to the scale and technology that can harvest fish at least cost, and to hold the corresponding quantity of landing rights. Recent economic analyses demonstrate that (in the absence of possible complications noted below) financial incentives would encourage the development of an efficient fleet in terms of its capacity and technology, and the market value of rights would reflect the full resource rents (Clark, 1979b; Moloney and Pearse, 1979).

The provision of rights to take specific quantities of a natural resource is rare in fisheries, but it is very common in arrangements for providing rights to other resources, especially in North America where public ownership is widespread. Water rights, timber quotas, grazing rights on public rangelands, oil and gas rights on "utilized" reservoirs, and waste discharge rights are all usually based on some form of licence which provides a specific quantitative right, in contrast to the rule of capture that applies in most fisheries.

In fisheries, the use of quotas has been confined largely to international agencies in allocating national shares of allowable catches. However, some examples of quantitative rights for individual fishing enterprises have begun to emerge. In the shrimp fishery off the coast of Labrador, the Canadian Government has recently introduced a licensing system that provides each licensee with a right to catch a fixed number of tons, and a similar arrangement is being considered for the scallop fishery on Georges Bank. On Canada's Pacific coast, the small abalone and herring roe-on-kelp fisheries are also regulated in this way. And in a particularly interesting development, herring fishermen in the Bay of Fundy, operating under licences that restrict access, have recently organized themselves into a "club" through which the allowable catch is allocated among the members as vessel quotas. While this report was being written, Italy introduced a new management system for its clam fishery which involves a quota for each licensed enterprise (see below).

The strong appeal of this method is that it eliminates the basic cause of overcapacity and inefficiency; rights to specific quantities of fish largely remove the incentives of individual fishermen to protect and increase their shares of the catch by defensively and competitively increasing their fishing power. It also eliminates much of the risk that fishermen face about their prospective catch under other arrangements. Moreover, it is uniquely adaptable to changing conditions. If costs fall or fish prices rise, no automatic tendencies to expand capacity will result; the value of rights will simply increase. If more fish become available, the authorities can sell additional rights, and if they stand ready to purchase rights, the catch can be reduced when necessary without any loss to fishermen.

There are two other conspicuous advantages of this approach. One is its simplicity, which derives from the fact that it creates economic incentives for fishermen to behave efficiently in their own interests. The other is that it lends itself to any desired division of the benefits between fishermen and the licensing authority. If the rights are issued without charge, the gains will accrue entirely to the recipients, as profits if they exercise the rights, or as capital gains if they sell them. If the issuing authority sells them at their competitive market value, it will capture all the benefits. And between these extremes, the system of rights can be supplemented with a variety of licence fees, annual charges, taxes or royalties which can divide the gains in any desired way without necessarily affecting incentives for efficiency.

Some of the problems associated with other regulatory systems would arise under a regime of quantitative rights as well. First, is the question of initial distribution of rights. Again, they might be distributed by auction, or allocated by some more arbitrary method such as awarding them without charge to enterprises established in the fishery. For example, the new quantitative rights might be allocated to established fishermen in proportion to their shares of the catch over the previous one or two years, and if the fishery is already subject to licensing, the licences could simply be converted to these quantitative rights. But while the method of initially allocating the rights has important implications for the distribution of benefits, it will have no lasting effect on the efficiency of the system because an active market in freely transferable and divisible rights will ensure that they will sooner or later be reallocated among those who can derive the highest value from them.

Second, there is the question of the term of these rights, which may be issued in perpetuity, annually or seasonally. There is little to be said in favour of short terms on economic grounds; they increase the cost of administration and reduce the security of fishermen. Licences that authorize an annual catch even in perpetuity are no less flexible, as long as the authority is prepared to buy and sell them as circumstances dictate. Longer terms will simply increase their market price (Moloney and Pearse, 1979).

Third, in certain fisheries the stock is thinned by fishing, raising the cost per unit of catch as the season progresses. This creates an inefficient reaction among fishermen in the form of competitive haste. This incentive will be weaker where the right to a catch is assured than when each fisherman's catch is open to pre-emption by others, but in some fisheries it may be strong enough to warrant control. In such cases, the solution would be to specify rights by the part of the season in which they may be exercised; later rights would thus be less valuable. Similarly, where the fishery covers several stocks or fishing grounds which require separate management, rights might be specified with respect to location.

Fourth, many fisheries are complicated by catches of mixed species, many varieties of gear, and fleets that move from one fishery to another (Huppert, 1979). A system of quantitative rights specific to each stock or mixture of stocks that requires separate management should minimize these administrative difficulties and encourage efficient joint product fishing operations.

More difficult to accommodate would be stocks, such as some of the clupeoids, that are subject to fluctuations of such magnitude and unpredictability that they call for very quick changes in fishing activity. It has been suggested above that quantitative rights offer

certain advantages in flexibility, but there may be cases where adjustments through the market for rights would be too slow, and suitable regulation will require the support of emergency powers to close areas or seasons at short notice. But none of these problems is unique to a regulatory system based on quantitative rights, and in most cases their solution would be more difficult under an alternative regime.

Finally, enforcement may present special problems because a system involving quantitative rights, like one based on royalties on landings, will create incentives to avoid reporting catches. The difficulties of enforcement will obviously vary, depending upon port landing and marketing arrangements, the market value of rights, and other circumstances. However, to alleviate these difficulties it is possible to introduce offsetting incentives to report catches fully. For example, the authorities might initially allocate less than the total allowable catch, the remainder to be auctioned or otherwise issued seasonally. In fisheries subject to wide stock fluctuations, this could add additional flexibility in adjusting catches. Moreover, if fishermen were given the privilege of obtaining these supplementary rights free, or at a preferred rate, in quantities equal to some proportion of their reported catch in excess of their basic right in the previous year, they would have strong incentives to fully report.

The advantages and disadvantages of this approach to rationalization can now be summarized under the several criteria for evaluation.

a) Effectiveness in Controlling Fleet Capacity

Quantitative rights issued to individual fishing enterprises offer a direct way of eliminating the incentives to expand fishing capacity beyond that needed to take the available catch efficiently.

b) Implications for Technological Efficiency

This approach will encourage adoption of the economically most efficient technology in any fishery. In this respect it is superior to any other method, because it removes even the incentives to adopt special technology and strategic behaviour in competing for the catch where the role of capture applies (Moloney and Pearse, 1979).

c) Adaptability to Changing Conditions

In this respect, also, a system based on quantitative rights is superior to any other insofar as once it is in place, it can be largely self-regulating. Changes in prices, costs or technology will not require any new intervention by the regulatory authority; the effects will be manifested entirely in the value of rights, without creating any tendencies to change the efficient level and composition of effort. The market for rights will provide a mechanism for the regulatory authority to adjust the catch to fluctuations in stocks. It should be noted that such purchases and sales would not involve any compulsory impositions on fishermen, and do not necessarily imply any long-term financial burden on the regulatory agency.

d) Effect on Distribution of Effort

This approach eliminates the incentives for inefficient distribution of fishing effort that exist in unregulated fisheries. Rather than compete for a share of the most accessible fish, fishermen would seek their catch wherever it could be taken at least cost. Where circumstances call for separate management of several stocks or fishing grounds, this might be facilitated by providing separate rights for each.

e) Distribution of Benefits

This approach lends itself to any desired distribution of the economic gains from rationalization between the holders of the rights and the government. The division of financial benefits will be governed by the method chosen to allocate the rights, especially whether they are sold or allocated without charge. Moreover, the system of rights can be supplemented with a variety of fees, taxes or royalties to alter the pattern of distribution of the benefits in any desired way.

f) Dislocation and Employment Effects

Depending upon how the scheme was introduced, this arrangement need not cause any dislocation in the fishery. Even if the fishery were overexpanded, there would be no necessity to force its contraction; the catch would gradually be consolidated among a smaller number of fishing units as a result of their incentives to improve their individual profitability. But unlike a system based on landings taxes or royalties, this arrangement would improve the position even of those who leave the fishery; their share of the catch will be secured, it will assume a market value, and its sale would be entirely voluntary.

g) Administrative Complexity and Cost

In its simplest form, this approach implies a very light administrative burden. Once the rights have been issued, market mechanisms and incentives can be relied upon to effect efficient results. The exception may be enforcement, especially the enforcement of full reporting of catches, but it is possible to introduce rewards for full reporting that would mitigate this difficulty. In any event, reliable catch data are needed for other management purposes also.

Another possibly important effect of this system is that, because it provides the participants in a fishery with a clearly defined interest in a share of the harvest, it is likely to encourage their cooperation in management and enforcement. This is much less likely under controls based on royalties or restrictive licensing of inputs, or under any circumstances where the rights to a catch are undefined.

The advantages of quantitative rights, as a mechanism for regulation are very profound, and the conclusion that it is the most promising of the alternatives is shared by other investigators.

> "To summarize (among the three alternatives of restrictions on inputs, taxes on landings, and vessel quotas) catch quotas appear to offer the best alternative, in terms of feasibility and efficiency. A limited entry program, which may be considered as a necessary prerequisite to the allocation of quotas, does not by itself lead to efficient exploitation of the fishery. Taxation will generally not be feasible as the sole means of regulating a domestic fishery, but could well be used in conjunction with an allocated quota system for the purpose of sharing benefits between fishermen and the state." (Clark, 1979a, p. 19).

But while such quantitative rights arrangements are widely used with satisfactory results in regulating the use of other common property resources, they are rare in fisheries policies. As a result, in spite of the attractions of this approach as a management technique, a major obstacle to its wide adoption in the near future is its unfamiliarity, and its conflict with long traditions of open competition for a catch limited only by luck and the ingenuity of fishermen. Even though fishermen could clearly benefit from a system of well defined rights, experience suggests that they will resist such basic and uncertain reforms. However, these difficulties may be diminishing. Already a few examples of quantitative rights schemes are in place, and favourable experience will become known with time. Moreover, many important fisheries are now operated under restrictive licences which can be converted to quantitative rights, and with increasing appreciation of the need for controls on fishing, this change may be considered more receptively.

Scholars of law and economics suggest that public controls and systems of rights evolve in response to rising resource values and, concomitantly, the increasing gains to be realized from eliminating the inefficiencies and waste associated with unregulated activity (Demsetz, 1967). Where administration costs are high and resource values low, the regulations are suitably crude, but as potential values rise more sophisticated forms of regulation and property rights can be expected to develop. A fishery licensed to restrict entry provides the participants with a much more exclusive "property right" than they would have under noncontrolled access, and the right to take a specific quantity of fish provides an even more well defined right (Pearse, 1979). As the value of fish resources rises, fisheries may thus provide a test of this theory of institutional evolution.

PART II

POLICY DEVELOPMENT IN MEDITERRANEAN TRAWL FISHERIES

THE MEDITERRANEAN FISHERIES

It is not appropriate, in this report, to attempt a detailed description of either the fish resources in the Mediterranean Sea or the industries dependent on them. This information has been published elsewhere (e.g., Levi and Troadec, 1974). However, in order to provide some context for the subsequent discussion of regulatory policy in Mediterranean countries, a few general observations about the condition of the stocks and the harvesting sector, drawn from the work of others, are provided in the following paragraphs (readers familiar with Mediterranean fisheries may prefer to skip this section).

The biological productivity of the Mediterranean is relatively low. However, both primary and secondary productivity vary considerably among different parts of the sea, reflecting the varying availability of nutrients. Most commercial stocks are concentrated above the continental shelf, which is generally narrow except in the northern Adriatic, the Black Sea and off the eastern coast of Tunisia. Small pelagic species, mainly anchovies and sardines but also significant quantities of bonitos, mackerels and sardinella, comprise the largest category of catch. More valuable in unit value are the demersals; these are found in wide variety, but red mullets, hake, sole and other flatfish and sparids are among the most important species. There is also a large harvest of molluscs and crustaceans, consisting of mussels, octopus, cuttlefish, small shellfish and shrimps and prawns. The catch, summarized in Table 1, is generally of highly valued species, and the demersal fish, molluscs and crustaceans, especially, command high prices in food markets. Thus, while the total Mediterranean catch of 1.3 million tons in 1974 accounted for only about two percent of the world total, its value of some US$ 700 million represented about five percent of the world total.

Although the stocks along the coasts have been exploited for centuries, there appears to be widespread agreement that the fish resources of the Mediterranean are not yet fully exploited. This generalization must be qualified, however, because the pressure of fishing varies widely among regions and stocks, reflecting the variations in productivity of the sea, the differing levels of economic development of coastal countries, the value and accessibility of the resources off their shores, and the adequacy of their resource management policies.

Fishing pressure is heaviest on the demersal stocks in the northwestern part of the Mediterranean basin where the European countries take large catches. During the last three decades, exploitation of some of the most highly valued species in this region has apparently reached, if not surpassed, the maximum sustainable level, and some, such as sole, hake and Norway lobster have shown signs of overfishing. Pressure on demersal stocks is also heavy in the northeastern part of the Mediterranean, including the Adriatic Sea which is the most productive part of the Mediterranean and the Agean Sea where lower natural productivity of the waters leaves stocks more vulnerable to overfishing. In contrast, it is believed that stocks off the southern and eastern coasts are not fully exploited. Estimates of the maximum sustainable yields of demersal species in the Mediterranean have been made by Gulland (1971), and Levi and Troadec (1974); the latter suggest that more intensive and diversified exploitation of certain stocks, coupled with improved management and fishing methods, could yield a total commercial catch of 500 000 t, a considerable increase over the recent level shown in Table 1.

Table 1

The Mediterranean catch by major species groups, 1966 and 1976

Major species groups	1966	1976
	(000 t)	
Demersals	257.0	294.0
Coastal pelagics	350.1	709.6
Oceanic pelagics	15.6	19.8
Diadromous species	13.6	7.5
Not included above[a]	242.1	223.7
TOTAL	878.4	1 254.6

a/ Catch not identified by species in original data

Source: FAO (1978d) Table 2.00. (See source for greater detail)

Most of the inshore stocks, traditionally exploited by artisanal fisheries, show evidence of inadequate management and of adverse effects of pollution, especially off the coasts of the more developed countries. Information on pelagic stocks is poor, but certain small pelagic species, mainly sardines and anchovies, and stocks of deep-sea crustaceans, appear capable of significantly larger catches (FAO, 1978a).

The Fisheries

Most of the Mediterranean fisheries can be classified under one of relatively few distinctive types.

1. Inshore fisheries

Inshore (or coastal, or artisanal) fisheries comprise the oldest category, and are of considerable sociological as well as economic importance. They consist of small, usually motorized and sometimes open boats. Typically, they carry several types of gear ranging from trammel nets and lines to dredges and traps, or are capable of changing gear. Some techniques, such as beach seining, do not involve vessels. These inshore operations are found in all coastal countries and probably employ more fishermen than any other category, although the employment is often part-time. In general, they exploit valuable species and sell their catch in local markets for fresh food fish along the coasts.

2. Demersal fisheries

Most coastal states have a semi-industrial fleet of trawlers that exploit demersal stocks, and this has been the fastest growing sector in Mediterranean fishing. Typically, some variant of the Italian trawl, a bottom trawl that catches a wide variety of demersal food species, is employed (an exception is the North Sea beam trawl, which has been adapted to Mediterranean conditions in Italy where it is called "rapido"; up to four of these trawls can be towed by large vessels to catch flatfish).

In many countries, a large part of the demersal catch is discarded, mainly undersized fish, inedible trash fish, and species unknown in local markets. Recent trends have been toward larger vessels and increasing engine power (Dremière and Nédélec, 1977).

3. Pelagic fisheries

Fishing for pelagic species, mainly sardines and anchovies, is carried out with two major types of gear.

a) Light seining

Light seines (lamparos) are the oldest type of semi-industrial gear for pelagic species, and are still the most common except along the Adriatic coast of Italy (where they have been replaced by "volante" trawlers). This technique of purse seining at night is constrained by the phases of the moon, the state of the sea, and (because it requires a large crew) the availability of labour. It continues to be profitable where port markets exist for fresh sardines and anchovies as food.

b) Pelagic trawling

Pairs of vessels towing pelagic trawls (called "volante" in Italy and "chalut-boeuf" in France) have rapidly been displacing light seines in recent years. The catch is usually processed for oil and meal.

4. Other fisheries

There is a considerable variety of minor types of fishing, including tuna traps along the coast, tuna seiners and longlining for species such as swordfish.

The fleets of the countries bordering the northwestern and northeastern parts of the sea account for by far the largest proportion of fishing power in the Mediterranean and most of the total catch, as Table 2 indicates. These are the regions where the pressure on stocks is greatest, and some of these countries have taken initial steps to control expansion of fishing capacity. In contrast, most of the coastal states of North Africa are promoting expansion of their fleets as part of their economic development programmes.

The great extensions of coastal fisheries jurisdiction that have recently been declared by many coastal nations have not yet occurred in the Mediterranean. Some fishing off the coasts of certain countries is carried out by vessels from other countries, notably by Italian vessels off Tunisia and Yugoslavia. However, most fleets confine their fishing to the shelves and slopes off their nation's coast, and few areas are fished by more than one nation's fleet.

Table 2

Total catch in the Mediterranean and Black Seas, by major countries, 1966 and 1976

Country[a]	1966	1976
	(000 t)	
Italy	307.1	357.4
USSR	296.8	347.2
Spain	78.4	147.0
Turkey	n.a.	128.1[b]
Greece	52.8	54.1[b]
France	35.1	46.4
Algeria	21.6	35.1
Yugoslavia	27.1	34.9
Tunisia	8.9	34.5
Morocco	9.5	25.9
Other countries	41.1	44.0
TOTAL	878.4	1 254.6

[a] Listed are the ten countries reported to have caught more than 25 000 t in 1976, in order of size of catch. No other country is reported to have caught more than 8 000 t in that year

[b] Provisional estimate

Source: FAO (1978d) Table 1.00

POLICIES FOR REGULATING FISHING CAPACITY AND EFFORT

In order to provide context for the discussion of measures for regulating fishing capacity in this report, a review was made of the arrangements in six of the most important Mediterranean fishing countries: France, Greece, Italy, Spain, Tunisia and Yugoslavia. The regulatory policies and institutional arrangements in each of these countries are described in Appendix I. While there are other countries bordering the Mediterranean that have adopted measures for controlling commercial fleets, this group includes those that appear to have taken the most ambitious steps so far in regulating fishing capacity as well as some that have not yet addressed the problem. This selection of countries also embraces advanced industrial nations as well as examples of those in early stages of industrialization, a variety of political systems, some with and some without a state fisheries sector, and considerable variation in the scope for fisheries expansion.

The review of the regulatory policies of these Mediterranean countries in Appendix I reveals a growing concern about methods of regulating capacity in trawl fisheries. However, the approaches taken vary considerably, and they are likely to vary also in their effectiveness in efficiently regulating the industrial development of fishing fleets.

At the risk of oversimplification, fishing nations can be divided into two groups; those with fleets that already suffer from excess capacity and those whose fleets do not yet fully exploit the available resources. With respect to trawl fleets exploiting demersal stocks, at least, France, Italy and Spain are examples of the former. In contrast, Tunisia and Yugoslavia are currently taking steps to develop additional capacity. Greece is an intermediate case insofar as the scope for expanded catches is uncertain, and government policy is directed mainly toward fleet modernization rather than expansion.

Traditional Controls - (gear restrictions, area closures and restrictions on fishing time)

All of these countries impose a variety of restrictions on fishing gear, most restrict trawling in certain areas, and some enforce seasonal, weekly and daily restrictions on fishing time as well. In recent years some significant progress has been made through national and international effort to introduce regulations to improve the composition of the catch, to prevent destructive fishing methods and to serve other purposes apart from regulation of fishing capacity. For example, nearly all Mediterranean countries have now adopted a minimum mesh size for trawl nets of 20 mm (40 mm stretched) and many specify a minimum size for most fish of 12 cm. Countries in the western Mediterranean prohibit trawling within three nautical miles of shore (six miles in Spain, one mile in Yugoslavia) in order to protect young fish that seasonally migrate inshore and to prevent conflicts with artisanal gear. In most countries such measures are accompanied by a variety of regulations that prohibit destructive gear, restrict fishing to certain depths or to certain seasons and by other means protect spawning and immature fish or their environment.

As explained in Part I of this report, such controls can serve a valuable purpose in protecting stocks from destructive forms of fishing, in improving productivity or the quality of the catch, and in preventing conflicts among gear on the fishing grounds. In Italy and Spain, restrictions on fishing time have also served the purpose of improving working conditions. However, restrictions on gear, fishing time and area closures do not afford efficient means of controlling total fishing effort because they do nothing to prevent wasteful expansion of fishing capacity. Indeed, when these methods are used for the purpose of reducing the pressure of fishing on stocks, they tend to accommodate excess capacity by reducing its productivity, by enforcing inefficient fishing techniques and underemployment of vessels and crews.

Nevertheless, it is clear that the fisheries authorities in some countries, lacking powers to control expansion of fleet capacity, have used such measures to protect heavily exploited stocks from overfishing. Examples include prohibitions on pelagic trawling in France and Spain, restrictions on the length of nets in many countries, and fishing closures

at certain seasons or in certain areas that serve no specific purpose other than relieving fishing pressure. Clearly, the problem of excessive effort is the result of excess fishing capacity, and to be solved efficiently it will be necessary to find means of controlling the expansion of capacity. Only if capacity is controlled will it be possible to allow the most efficient fishing methods and technology without the risk of overfishing.

Subsidies

Most countries provide subsidies of one form or another for vessel construction or improvements; these typically take the form of grants, preferred loans and fiscal concessions. Such subsidies obviously conflict with policies aimed at controlling expansion of fleet capacity. Significantly, in France, Italy and Spain, where fishing capacity appears to have reached or exceeded the level required to harvest the available stocks, subsidies of this kind are either being phased out or restricted to vessel modernization. In Greece, the subsidy available for construction of new vessels may be increased if the owner undertakes to retire an old vessel.

Vessel Licensing

All of the countries examined employ some form of vessel licensing, and several use this device to control fleet development. In France and Spain, no new licences are issued, reflecting the governments' effort to prevent further expansion in fleet capacity. In Tunisia, new licences are issued only for fishing in those areas which are not already fully exploited. In Greece, licences are issued for new vessels only if they meet prescribed minimum standards of size and power. And in both Greece and Tunisia, additional licences may be issued only to established fishermen. Apart from certain requirements relating to safety and seaworthiness, there are no restrictions on the issuance of licences in Italy and Yugoslavia.

In Italy, in spite of clear evidence of excess trawl capacity, there are no governmental controls on fleet expansion. Certain cooperative organizations of fishermen on the Adriatic coast have taken voluntary measures to regulate fishing effort, but because they have no legal power to regulate access, their ability to control fishing power is limited.

All the countries that have taken significant steps to control fishing capacity have adopted the approach referred to in Part I as "direct restrictions" on fleets. Since engine horsepower is a major determinant of the fishing power of trawlers, restrictions on engine size have often been chosen as the means of controlling the capacity of trawl fleets, notably in Spain, France and (in certain areas) Yugoslavia. Two distinct types of control are evident. One involves controlling the total power of the fleet entirely through the licensing system; as in Spain, each vessel owner is licensed to engage a specified horsepower, so the aggregate horsepower of the fleet is limited. The other approach consists of general legislative restrictions on the engine power of vessels. Thus France combines a simple licence limitation of the number of trawlers with a legal requirement that none may employ an engine exceeding 430 hp.

The difference between these two general approaches to regulation of fishing capacity is important. When the engine power of individual vessels is restricted by law, the specified maximum horsepower is necessarily a more or less arbitrary limit to which each vessel owner must adhere. This gives rise to several difficulties. First, unless all vessels are already equipped with the maximum engine power, this limit will not prevent further expansion in this dimension of fishing power. Second, the specification of engine power raises technical difficulties, and there are ways of increasing traction even with a fixed horsepower, which further weaken the effectiveness of such restrictions. Third, and probably most importantly in the long run, such a limit on engine power creates strong incentives to increase the fishing power of vessels by other means. This is likely to lead to technological distortions and attempts to thwart the controls, and may necessitate restrictions on additional dimensions of fishing power.

In contrast, when engine power is controlled through vessel licences, as in Spain's system of licensing horsepower, the total power of the fleet is limited yet the power of individual vessels can vary. The licence becomes a right to engage a prescribed amount of horsepower, and by simply restricting the issuance of new licences further expansion in the total engine power of the fleet can be effectively controlled. Further, if the licences are transferable, vessel owners can combine them or divide them to adjust the scale and efficiency of fishing units and to accommodate technological change. This has the additional advantage of blunting incentives to circumvent the controls. Thus, parallelling the Spanish licensing of horsepower, licences issued under Canada's Pacific salmon fleet rationalization programme authorize each vessel to employ a specified number of tons of vessel capacity, so it is the fleet's total tonnage that is controlled. The market determines the value, per ton, of licences, and transfers have accommodated a great deal of modernization and structural change in the fleet.

Where no new licences are issued, new vessels can be introduced only by retiring licensed capacity. In France, the limited number of vessel licences requires that a licensed vessel must be retired in order to introduce a new one. Under Spain's system of licensed horsepower, a new vessel can be introduced only if an equivalent amount of licensed horsepower is retired. In Greece, retirement of older vessels is encouraged under the subsidy arrangements.

A variety of restrictions apply to the transferability of licences in the countries examined. In Greece, Italy, France and Spain, purchases and sales of vessels, with their licences, are relatively unrestricted. In Tunisia, the ownership of vessels is closely controlled through the licensing system, and purchasers must be established fishermen. In Yugoslavia, the ownership of private fishing units, like other private enterprises, is limited by the number of workers that may be employed in each. In all cases, licences are transferable only with the vessels to which they are appurtenant. As explained further in the following section, the transferability of licences alone, independently of vessels, would provide certain advantages in flexibility for both vessel owners and the regulatory authorities.

In all of these countries, fishing licences are issued either without charge or for only a modest fee. Nevertheless, in France and Spain especially, these rights have become very valuable in private transactions. This suggests an opportunity for such governments to share the value of these resource rents without adversely affecting the incomes of fishermen (as distinct from the asset values of vessel owners). The terms of licences vary widely from one year to indefinite terms.

Control of the Distribution of Effort

A serious management problem throughout the Mediterranean is the imbalance between the distribution of fishing effort and the productivity of different stocks and grounds within the reach of trawl fleets. Of the six countries reviewed, only Tunisia has taken significant legislative action to enable the regulatory authorities to deal with this problem through area controls.

Fleet Reductions

None of the countries examined has a programme for reducing the capacity of its fishing fleet, although in some cases fishing capacity exceeds substantially the level required to efficiently harvest the available resources. In such cases, reduction of capacity would undoubtedly enhance returns of labour and capital and generally improve the economic performance of the fishing industry. Significantly, the European Economic Community has been considering a programme for reducing excess capacity of its member countries.

Two final observations about fisheries policies in the Mediterranean should be made. First, the need for regulation of fishing capacity and the distribution of effort is already urgent in some countries and will soon become so in others. The benefits to be gained from effective controls of this kind in terms of social and economic improvement and resource management are undoubtedly substantial, and the sooner initial steps are taken the easier they will be to introduce and the greater the gains that will be realized.

Second, it is difficult to avoid the conclusion that in certain Mediterranean and other fishing countries, solutions to fisheries problems lie not only in introducing new management policies but also in eliminating policies that aggravate poor economic performance. Certain forms of subsidies on vessels or on fuel, tax concessions, social security arrangements and other types of intervention encourage overcapacity and overfishing, and disguise the low real returns to fishing. Effective reforms in fisheries policy must therefore be concerned with the broad framework of economic and social policy within which fishing industries operate.

All of the national policies examined in this study, will, in the long run, benefit from reforms to enable more effective means of controlling total fishing capacity, to improve the distribution of fishing effort, and to achieve other objectives. The remainder of this report deals with these problems.

PROBLEMS AND PROSPECTS FOR FUTURE POLICY DEVELOPMENT

This concluding section deals with issues that must be faced in improving arrangements for controlling fishing effort in the Mediterranean. It identifies a number of important lessons to be learned from the experience of the Mediterranean countries reviewed in Appendix I and summarized in the preceding section, and of other countries that have introduced rationalization measures, in order to draw conclusions about appropriate directions for policy development. Early in this report it was emphasized that the most suitable arrangements will vary among Mediterranean countries because of their differing economic, social and political circumstances. Moreover, each country faces different problems of data, of resource management, and of administrative capability. The following discussion is therefore confined to general considerations that are relevant in designing policies for regulating effort in Mediterranean trawl fisheries.

Prescriptions of suitable reforms in public policy inevitably invoke judgements not only about what is feasible but also what is politically and socially desirable for particular societies. Certain judgements underlie the conclusions in this section, and they should be explicit at the outset. First, most of the regulatory problems examined in this report arise only where fisheries are exploited, at least in part, by independent private entrepreneurs whose motivations include a desire to protect and improve their incomes. In this context, it is assumed here that regulations that create incentives for fishermen to behave, in their own self-interest, in the manner sought by regulatory authorities are preferable to regulations based only on compulsion. Further, it is presumed to be beneficial to take advantage of normal market processes that can promote the regulatory purpose. It is assumed also that a high priority should be placed on administrative simplicity in designing the kind of new institutional arrangements required for regulating fishing effort. Experience suggests that simple arrangements that build on economic incentives (rather than suppress them) will be more manageable and effective. In short, it is considered advantageous that the systems of controls be as self-regulatory as possible.

The question of who should enjoy the economic gains from a profitably fishery - whether fishermen, vessel owners or the government should be the beneficiaries of resource rents - is largely a political issue. Therefore no position is taken on this matter here. However, a regulatory system that allows flexibility in the division of these benefits is assumed to be advantageous. Further, even if the regulatory authority seeks ultimately to capture most of the resource rents, it is considered desirable that some benefits accrue initially to fishermen in order to facilitate their acceptance of the reforms.

Finally, it is assumed that any successful programme of fisheries rationalization must be implemented gradually, and with minimal disruption of established interests. This means that initial measures should lend themselves to modification and elaboration as the regulatory programme evolves over time.

The following discussion implies a rough sequence of considerations and steps in developing a rationalization policy. This progression is largely for expositional purposes, however, and should be modified according to the circumstances of any particular fishery.

1. Early Action

In nearly every case of which this author is aware, and notably in France and Spain, steps have been taken to control expansion of fishing capacity only after it has become excessive. This is not surprising, because the need for new innovations in regulatory arrangements is often not recognized, nor are they acceptable to those affected, until it becomes obvious that a serious problem exists. But when corrective measures are postponed until the problem becomes serious its solution is all the more difficult. Typically, by the time controls are introduced, not only is fishing capacity excessive but also the stocks have become more or less depleted, so that even greater reduction in effort is required for a time in order to allow stocks to rebuild. To prevent a fishery from overexpanding presents much less awkward administrative and political problems than reducing capacity, and avoids serious dislocation of employment, capital investment, and other established interests as well.

CONCLUSION 1. Fisheries authorities should initiate measures to regulate fishing capacity without delay, and preferably well before capacity has reached a level capable of fully harvesting the available catch.

This does not imply that the initial measures must necessarily restrict further expansion. Additional capacity may be desired in fisheries that are not fully exploited and, as in Tunisia, the regulatory system can be administered to accommodate growth. But it is important to establish the regulatory mechanism early in order to facilitate controls as the desired level of capacity is approached.

In the future, it should be easier to take preventive measures. The general tendency for fleets to overexpand is becoming better understood and increasing experience with controls in various countries should allay many of the fishermen's apprehensions about them. Some educational effort to broaden this understanding may be helpful in gaining acceptance of control policies.

2. First Steps for Fisheries with Scope for Expansion

The appropriate first steps in implementing a programme for controlling fishing capacity depend upon whether the fleet has already reached a capacity capable of harvesting the available catch. We consider first the easier case in which action is taken early, well before it is necessary to limit further fleet expansion.

Simple licensing

The first requirement is a simple administrative instrument to identify the fleet and to provide the foundation for a control programme. This implies some form of licensing. The form of this device is crucial. It should be simple, but it should be adapted to the character of the particular fishery, adaptable to unforeseen changes, and amenable to elaboration as the need to exercise control over fleet development emerges.

A decision must first be made about what is to be licensed. Various alternatives and combinations are possible, but a basic issue is whether to license fishermen, vessels, or units of gear. As explained in earlier parts of this report, there has been some experience with each of these; all present certain problems, and the best choice will be influenced by the circumstances of individual fisheries.

In the case of Mediterranean trawl fisheries, it seems likely that the licensing of vessels will be most suitable. It is the number and size of vessels that mainly govern the capacity of fleets; it is the employment of physical capacity (rather than of men) that is the main target of control; and vessels afford much more tangible and readily identifiable (and enforceable) subjects for licensing than do men. Licensing vessels rather than units of gear puts fewer constraints on technology, avoids certain complications about multiple-gear vessels, and is simpler to administer.

CONCLUSION 2a. As an initial step in implementing a control policy, a simple, adaptable form of licensing should be introduced to provide an administrative mechanism to identify the fleet and to monitor its development. Licensing of vessels will, in many cases, be most appropriate and practicable.

In many Mediterranean countries and elsewhere, a form of vessel licensing is well established for purposes of registration. These licences can be adapted for the purposes discussed here (as they have been in certain countries). In other cases, the introduction of licences or the power to restrict their issuance may require legislative amendment.

Licensing of vessel's fishing power

Well before the fleet reaches a size capable of fully exploiting the available stocks, and in anticipation of the need to control further expansion, licences should be modified to authorize the use of some basic dimension of the vessel's fishing power, such as its tonnage or engine power. Experience indicates that, if only the number of vessels is restricted, this will not be sufficient to prevent additional expansion of capacity because the fishing power of individual vessels will increase. When restrictive measures become necessary, vessel licences will therefore provide a much stronger means of control if they specify some basic and readily measurable dimension of vessel fishing power, as in the case of Spain's licensing of vessel horsepower.

> CONCLUSION 2b. Before it becomes desirable to restrict further fleet expansion, the licensing system should be modified to authorize some basic dimension of the licensed vessel's capacity, such as its engine power or tonnage.

If other suggestions made below are incorporated into the regulatory arrangement, this dimension of fishing power, which provides a superior (though imperfect) index of fleet capacity, will then become the subject of control.

Elimination of subsidies

Many countries, in an effort to stimulate development of their fisheries, have adopted various forms of subsidy arrangements for vessel construction. As the fleet approaches its needed capacity it is obvious that such stimuli will no longer serve the purpose of increasing production, and they will aggravate the problem of control. They should therefore be eliminated.

> CONCLUSION 2c. Before the fleet's desired capacity is reached, subsidies for vessel construction should be abolished.

Declaration of licence freeze

As the fleet approaches the capacity needed to fully harvest available resources, the licensing system described above can be used to temporarily stall further expansion. This implies a freeze on licences. A clear governmental pronouncement of this action will be called for to prevent misunderstanding and frustrated investment in new vessels. Experience suggests that special provisions will have to be made for vessels already under construction and for other special cases.

> CONCLUSION 2d. As the fleet's capacity reaches the appropriate level, the authorities should announce their intention to issue no additional licences, except for vessels already under construction and other special cases.

3. First Steps in Overexpanded Fisheries

Where the fleet has already reached or exceeded its desired capacity before any method of control is introduced, the initial steps raise more difficult problems.

Short notice

In many cases, the introduction of control measures has been preceded by events that encouraged fishermen to protect their interests by expanding fishing capacity before they were restricted from doing so. As we have seen, the number and size of vessels in the Spanish trawl fleet increased substantially in anticipation of the controls introduced in 1975. Similar behaviour was observed when restrictions were being introduced in Alaska, in Canada's Pacific salmon fishery, and in other cases. This is a rational response to imminent controls, and must be expected. But it clearly aggravates the problem to be solved and raises serious problems of equity.

CONCLUSION 3a. In already overexpanded fisheries, initial control measures should be introduced with as little advance notice as possible, in order to minimize pre-emptive expansion of fishing power.

This conclusion should not be interpreted to advocate hasty action; the design of appropriate control devices obviously needs careful study. But to the extent that political circumstances permit, it will be advantageous to minimize advance notice of the particular form of regulation to be introduced.

Licensing established units

The essential task is to introduce a system of vessel licences, if none is already in place, and for reasons already discussed these licences should authorize a basic dimension of vessel capacity, such as engine power or tonnage. A crucial issue that must be resolved at the outset is the manner in which licences are to be allocated and who will be eligible to receive them. In all cases of which this author is aware, licences have been granted, at little or no charge, to all fishermen or vessels (whichever was the basis for licensing) that were already active in the fishery. In some cases, evidence of a minimum level of landings in past years has been required, but this qualification was always low. Licensing all established units avoids dislocation of labour or invested capital at the outset and, apart from its purely economic implications, must usually be considered necessary in order to gain acceptance of any controls.

However, it will be necessary to define and identify the established fishing units in the fishery. In some cases eligibility has been limited to vessels that have been active in the fishery during a prior qualifying period of two or three years, and sometimes evidence of a minimum level of landings has been required; but these criteria can be applied only if certain data are available and reliable. Past experience suggests that difficulties are likely to arise in defining established fishing units, especially where information is meagre and where fishermen have incentives and opportunities to establish their eligibility before restrictions are imposed. The rules for eligibility must therefore be clear and firmly applied.

CONCLUSION 3b. In most cases, it will be necessary to grant licences to all fishing units established in the fishery. The criteria for establishing eligibility should be clearly specified and rigorously enforced.

Appeal procedures

Discretionary judgements will typically be necessary to establish eligibility in special cases, such as vessels currently under construction or vessels whose fishing activity during the qualifying period was involuntarily interrupted. Experience has shown that unless clear provisions are made for appeals, considerable difficulties can arise in dealing with such cases equitably and consistently. Moreover, the principles to be applied in judging such cases should be specified clearly, in order to avoid uncertainty and unwarranted appeals.

CONCLUSION 3c. A systematic appeal procedure should be provided to adjudicate eligibility for licences in special cases, and precautions should be taken against illegitimate pressures to issue additional licences.

4. Terms and Conditions of Licences

It has already been suggested that the most effective and practicable mechanism for initial control of fleet capacity is a system of vessel licences, and that these licences should convey the right to engage some basic dimension of the licensed vessels' fishing power, such as tonnage or engine power. It should be emphasized that only one such dimension of the fishing power of vessels should be specified in licences. This limits the scope for restricting capacity growth, but for reasons examined earlier, restrictive licensing of inputs should not be relied upon as the only means of controlling effort as the rationalization

programme evolves (see below). If as in Tunisia, several dimensions of vessels are simultaneously specified - such as length, tonnage, horsepower etc. - the licences effectively specify particular vessels. This leaves little or no scope for transferability of licences (see below) and restricts opportunities for technological improvements.

Transferability

A crucial issue is the transferability of licences. In Canada and the United States, particularly, this has been an issue of much confused debate, and in some cases transfers of licences have been restricted. One argument for prohibiting sales of licences is that the established fishermen who receive initial licences might otherwise succumb to cash offers for their fishing rights to their subsequent regret. Thus the Alaskan limited entry programme incorporates stringent restrictions on transfers of fishing rights held by native Indians in order to prevent them from losing their traditional fishing opportunities and creating social problems. This concern to protect licensees from their own decisions is not likely to be compelling, however, in the relatively sophisticated entrepreneurial environment of Mediterranean trawl fisheries. Another concern is to prevent monopolization of licences (or as in South Africa, their monopolization by processing companies). However, if necessary, this can readily be prevented by other means, such as a simple limitation on the number of licences that may be held by any party. A third argument is based on the conviction that private parties should not be permitted to appropriate, through the sale of a licence, the value of a right to exploit public resources. This argument, which has undoubtedly been influential, involves some confusion, because the question of transferability and the question of who is to enjoy the benefits of effective control are not necessarily linked. The distribution of any financial gains from rationalized fishing between the licensees and the government will depend upon the charges made for fishing rights.

There are, on the other hand, substantial advantages in transferable licences. Purchases and sales will soon establish a market value for the right to employ the licensed dimension of fishing capacity. This will afford vessel owners the opportunity to replace, improve and adjust the scale of their fishing units within the aggregate limits of fleet capacity provided under the licensing system. It has already been pointed out that the opportunity to purchase and sell the right to engage the restricted dimension of fishing capacity will provide vessel owners with a degree of flexibility that will blunt incentives to distort the structure of their vessels and to circumvent the control system. Moreover, the assets of vessel owners, in both their fishing rights and invested capital, will be secure insofar as their value will not be lost if they retire or die. Finally, an active market in licences provides a convenient mechanism for the regulatory authority to increase or reduce capacity through sales or purchases, without causing involuntary dislocation.

> CONCLUSION 4a. Licences should be transferable and divisable, to enable flexible improvement and replacement of fishing units within the total limitations of the fleet and to provide a mechanism for adjusting fleet capacity through market processes.

The licences provided for trawl vessels in certain Mediterranean countries are transferable with the vessel and their market value is well established. Provisions are made for replacing licensed vessels, but if the licences were transferable independently of vessels, a separate market for licences and vessels would almost certainly facilitate efficient fleet development. This arrangement is consistent with the policy relating to vessel replacement suggested above.

In some countries there may be special reasons for retaining some governmental control over licence transfers, such as apprehensions about the possibility of foreigners acquiring control of the fleet, fears about excessive industrial concentration, or other social and economic concerns. In such cases, transfers can be conditional on ministerial or official approval. But governments should be cautious in applying such conditions, because they create uncertainty and interfere with orderly market processes. This suggests that at least any requirement for approval should be accompanied by clear specification of the criteria to be used in withholding permission to transfer licences.

Term

Another matter that must be decided is that of the terms of duration of licences. The alternatives range from short, fixed terms (as in Tunisia) to essentially perpetual terms (as in France and Spain) and there is an infinite variety of intermediate possibilities. Superficially, shorter terms appear to offer more administrative flexibility, but this advantage may be more apparent than real. If licences carry only annual terms, for example, and renewal is not guaranteed, vessel owners will face a great deal of uncertainty in financing and planning their fishing enterprises. Hence such short-term rights tend to become more or less automatically renewable, and do not differ substantially from perpetual licences. Longer terms involve lower administrative cost, and under suitable arrangements (discussed below) can provide the needed flexibility of control over time.

Long terms afford greater security to vessel owners and thereby promote efficient investment planning. This purpose does not require licences of infinite duration, but it does call for terms long enough to cover the period of financial depreciation of the capital assets involved, which is likely to be a decade or so for trawl vessels.

If the fishery is in a relatively stable condition and future policy development is fairly clear, indefinite terms would be suitable and easiest to administer. But especially where future policy is uncertain, it may be advantageous to limit the terms of initial licences to, say, ten or fifteen years. This will provide an opportunity for a fundamental revision of the terms and conditions of fishing rights in the light of developments during that initial period. This does not necessarily mean that the full term of initial rights must expire before replacement rights are designed and made available.

> CONCLUSION 4b. The term of initial rights should be long enough, or should be renewable with sufficient certainty, to provide adequate security to vessel owners for efficient investment and financial planning of their fishing enterprises. In many cases, however, a finite term will facilitate future changes in the structure of fishing rights.

Charges

There are strong reasons for incorporating some form of charge for licences at an early stage, even if it is only a modest levy. First, experience shows that, especially where entry to a fishery is restricted, the established fishermen develop attitudes of proprietorship over the resources. This is often beneficial in fostering interest and cooperation in fisheries management, but at the same time it may increase resistance to governmental intervention. A charge for fishing rights can serve a useful psychological function in asserting the public interest in the natural resources. Second, a periodic levy may serve an administrative purpose in providing the means for obtaining current information about the fleet and the holders of licences. Third, as a rationalization programme develops and becomes more binding in a profitable fishery, there will be increasing economic justification to capture at least some of the resource rents in order to reduce incentives to expand capacity through technological changes within the licensing constraints, as explained in Part I. It will almost certainly be easier to do so if the principle of payment for fishing rights is established at an early stage. Finally, the revenue is likely to be attractive in itself. Some or all of the funds might be used to advance the rationalization programme by providing support for administratration and information, for assistance to private organizations, or for funding "buy and retire" activities (see below). This would undoubtedly reduce resistance to a public charge, but it may be imprudent to commit all such future revenues to these specific purposes.

The revenue device can take a variety of forms, but under initial licensing arrangements it will usually have to be administratively simple. A royalty on the catch has many advantages, but it may be administratively too difficult to introduce early in a control programme, except perhaps where there already exists a well established "fish ticket" system that can provide the authorities with reliable information on all purchases and sales of landed fish. In most cases, however, at least a routine annual fee is manageable. This might take the form of a simple annual licence renewal fee if licences are annually renewable, or annual dues required to maintain licences in good standing if their term is longer.

CONCLUSION 4c. Some sort of charge for the privileges conveyed under licences should be provided for at the outset or at an early stage of a rationalization programme. Initially, the amount of the levy might be only nominal, but it should preferably be recurrent. The charge is likely to be more acceptable if at least some of the revenues are initially ear-marked for the purposes of advancing the rationalization programme.

Legal foundation and comprehensiveness

If it is to be effective, a control mechanism obviously must have a firm legal foundation. If the controls depend on voluntary cooperation (like those introduced by certain Italian cooperatives), any success in improving the returns to fishing will attract additional entry into those fisheries. Without legal support, it will be difficult or impossible to prevent such additional capacity from frustrating the control programme.

The licensing programme should preferably encompass all the fisheries within a jurisdiction that can be exploited with the kind of vessels licensed, otherwise the limitation or reduction of capacity in one is likely to aggravate problems in another. Thus, for example, when entry to Canada'a Pacific salmon fleet was restricted, capacity increased in the already overcapitalized halibut fleet, a problem Alaska subsequently attempted to avoid by introducing a comprehensive programme in all fisheries.

CONCLUSION 4d. Initial licensing should be compulsory under law for all vessels engaged in the relevant fisheries, and it should include all the fisheries within the particular jurisdiction that can employ the type of vessels licensed.

5. Vessel Replacement Arrangements

As soon as licences are restricted, it will be necessary to specify a policy concerning the replacement of licensed vessels that become obsolete. One alternative is to prohibit replacements; this has a superficial appeal in cases where substantial reduction in fleet capacity is desired. But such a restriction raises serious problems. First, it is likely to be considered inequitable insofar as the value of a licence would depend on the age of each vessel. Second, it would threaten dislocation of employment and complete loss of assets if a vessel were retired, and therefore encourage owners to maintain old vessels long after they should be replaced in the interests of safety, efficiency and economy. And third, it may not be very effective in reducing fleet capacity because the life of a vessel can be prolonged almost indefinitely.

The alternative of allowing owners to obtain licences for new vessels on the condition that they retire an equivalent amount of licensed capacity, as is the case in France and Spain, is therefore likely to be more suitable in terms of equity, stability and efficiency. This arrangement is consistent with the principle of transferability of licences suggested above. Such a replacement policy will prevent expansion in licensed capacity, and any desired reduction in capacity can be accomplished by less problematical and more orderly methods (discussed below). A possible compromise that might warrant consideration for overcrowded fisheries is a requirement that double (or some other multiple of) the new capacity to be introduced must be retired.

Some regulatory agencies have found themselves under heavy pressure to issue new licences to vessel owners after they have constructed a new vessel. These pressures will be considerably easier to resist if licences can be purchased with or without vessels in the private market, as suggested below. Nevertheless, in most cases it will be desirable to impose a requirement that before a vessel is constructed a licence adequate to cover its restricted dimension of capacity must be acquired, or licensed vessel(s) with equivalent licensed capacity must be irrevocably committed for retirement.

CONCLUSION 5. Consistent with the transferability of licences, licensing of new vessels should be permitted on the condition that the owners simultaneously retire an equal amount of licensed capacity. To avoid subsequent difficulties, it may be desirable to require that a newly built vessel can be introduced into a restricted fishery only if the required licence is provided for before the vessel is constructed.

6. Monitoring

Once a restrictive licensing system is in place, its effect on the pattern of fleet development and the evolution of the fleet's fishing power should be watched continuously in order to assess the efficacy of the controls and the need for supplementary measures. This implies some form of systematic monitoring. It will be particularly important to identify the form and degree of technological distortions that result from the restrictions on certain dimensions of fishing power, and their consequences for the fleet's aggregate capacity and cost of inputs.

CONCLUSION 6. A programme of continuous monitoring should be initiated as soon as restrictive licensing is introduced, in order to assess the impact of the controls on the fleet's capacity and technology, and to assess the need for supplementary measures.

7. Control of the Distribution of Effort

Even before the capacity of a fleet has expanded sufficiently to fully utilize all the available stocks, the more accessible or vulnerable stocks and areas will usually begin to suffer from excessive fishing pressure. The failure of unregulated fleets to efficiently distribute their effort with respect to the potential yields of different stocks and fishing grounds within their reach is well known, and the absence of means to correct this has emerged as a serious management problem in certain Mediterranean trawl fisheries.

As soon as possible, regulatory authorities should therefore initiate controls over the distribution of effort. This typically presents difficulties of enforcement, and should therefore be as simple as possible to begin with. As is being done in Tunisia, broad, well defined management zones should be demarcated with reference to the occurrence of separate stocks and the pattern of fishing pressure.

There are several possibilities for effecting control over the distribution of fishing pressure among zones. The traditional procedure of closing certain areas periodically in order to force the fleet into others creates great economic inefficiency, as explained in Part I. A system of royalties, with sufficiently higher rates on the catch from zones under greater pressure, could provide incentives to allocate effort appropriately among zones if it could be effectively implemented; but this would require extremely close surveillance, complicated administration and rigorous enforcement. In most cases a more practicable approach would be to modify the licensing system to provide supplementary licences to fish in each zone, as in Western Australia's rock lobster fishery (Meany, 1979). These supplementary licences can be allocated, restricted in number, and transferable in the same ways as (but separately from) basic licences. Clear identification of vessels carrying these rights, through a device such as a numbered plate displayed on the exterior of vessels, would facilitate enforcement.

CONCLUSION 7. Measures should be taken to enable regulation of the distribution of fishing effort among stocks and regions. This requires identification of suitable management zones and selection of some control mechanism. Regulation by means of supplementary licences for each zone may be most profitable and effective.

8. "Buy and Retire" Arrangements

Where fleets are overexpanded when licences are introduced, or later become overexpanded, so that rationalization requires reduction, capacity can be withdrawn by governmental purchase of licences or licensed vessels that are offered for sale, and retiring them. Experience with "buy and retire" arrangements has shown that this can be an effective way of eliminating licensed capacity from the fleet without causing involuntary dislocation of fishermen or their invested capital. Fleet reduction can be accomplished very quickly by this means if purchasing is pursued vigorously enough. But if the regulatory authorities become the dominant buyer in the market for licences, they will find themselves setting the price, the price will be higher than otherwise, and the programme will be correspondingly more costly. This may not be considered serious, and in any event must be weighed against the benefits of faster fleet reduction.

Where vessels are purchased with licences, and the licences are eliminated there remains the problem of disposing of the vessels. This illustrates another advantage in allowing free markets for licences and vessels separately. Then, if licences alone are purchased, the problem of disposing of vessels does not arise. Even if vessels are purchased with their licences and the licences withdrawn, the vessels alone will retain a market value because buyers will be able to purchase licences also. In some Mediterranean countries the market for trawl vessels and the potential market for licences are so small that a governmental intervener would inevitably influence prices. But for trawl vessels, at least international markets appear to be very competitive.

There has been some experience in Canada with financing "buy and retire" schemes by allocating revenues from licence fees to a fund for this purpose. This has some administrative advantages, but more importantly it effectively channels the revenues from levies on vessel owners back to vessel owners, reducing the resistance to such levies.

Even where fishing power is not already excessive, it may become so with technological advances and other changes. Moreover, in cases where restrictions have been imposed on gear or on areas and times of permitted fishing for the purpose of controlling fishing pressure, these restrictions can be relaxed if fishing capacity is withdrawn under a "buy and retire" arrangement.

> CONCLUSION 8. Where fleet capacity is excessive, regulatory authorities should implement a "buy and retire" programme, intervening as a purchaser in the market for licences to withdraw licensed capacity without causing involuntary dislocation. There may be administrative and political advantages in funding this programme through earmarked revenues from licence fees.

9. Long-term Policies

All the above conclusions relate to the early steps in establishing basic licensing systems that will provide a preliminary mechanism for administrative control. This is, for most Mediterranean countries, the immediate problem. But for the reasons discussed at length in Part I, control over only one dimension of the fleet's fishing capacity will probably be insufficient in the long run to prevent further redundant expansion in the total capacity of the fleet.

Once licences are restricted, they will begin to take on a market value. At this stage the incentives will emerge to alter the composition of fishing units to increase their fishing power within the constraints of the licensing system as discussed in Part I. The strength of these incentives will depend upon the profitability of the fishery. As they increase, threatening to expand capacity and to distort technology, the maintenance of an efficient fleet will require additional control measures. The suggestions on the preceding pages are designed to establish a licensing arrangement that lends itself to elaboration as it becomes necessary to cope with these pressures. The remainder of this section deals with more

sophisticated control arrangements. The conclusions are more tentative, because the best structure of a more rigorous policy for regulating fishing capacity will depend heavily on the political, legal, economic and administrative circumstances of particular countries and their fisheries.

There are two main alternatives, as discussed in Part I; regulation by royalties on landings and allocation of catch quotas to individual fishing units. Or, these measures can be combined. But both are likely to meet resistance because they involve a break with the traditional rights of fishermen to whatever he can catch, and both raise additional problems of administration and enforcement.

Royalties on the catch

The use of royalties to eliminate incentives to expand fishing power is theoretically attractive, but this approach suffers two serious practical disadvantages as a primary method of controlling fleet capacity. One is that the rates must capture all income in the fishery in excess of the minimum required to cover the costs of efficient operations; any unappropriated surplus will encourage expansion of fishing capacity. This would require extremely flexible and delicate adjustments to the royalty rates, which would have to vary among areas and over time as costs and prices change; such a demanding task cannot reasonably be expected of most regulatory agencies. The other limitation is that, to the extent that royalties are used to capture emerging resource rents, they preclude improvement in the incomes of fishermen and hence may conflict with an important objective of the rationalization programme.

These considerations suggest that royalties, alone, are not likely to offer a practical means of completely preventing expansion of capacity or other inefficiencies in a profitable fishery. But it must be emphasized that even a crude system of landings royalties would serve the valuable purpose of dampening financial incentives to increase fishing power. Such charges can therefore be a valuable adjunct to a rationalization programme.

> CONCLUSION 9a. As a fishery becomes profitable, consideration should be given to the possibility of introducing royalties on the catch, to dampen vessel owners' incentives to expand capacity by altering technology. To the extent that it is administratively feasible, the royalty rates should vary among zones and over time according to variations in the potential net value of the catch.

Quantitative rights

As explained in Part I, a permanent regulatory system based on quantitative rights, or vessel quotas, issued to individual fishing enterprises has many advantages. Its strongest attraction is that it eliminates the incentives that are the fundamental cause of wasteful expansion of fishing capacity, distortions of fishing technology, and inefficient deployment of effort. It also permits any desired portion of the economic benefits of rationalization to accrue to fishermen without affecting efficiency. Another significant advantage is that such a control system, if suitably designed, can be easy to administer. However, this approach implies the most unfamiliar and fundamental change in the nature of fishing rights, and so it may be difficult to adopt. It also raises certain problems of enforcement. But there are ways of alleviating these difficulties (discussed below) and they should be weighed against the very strong advantages of this technique as a long-term policy for efficient fishery regulation.

It is worthwhile to consider how such a system might be adopted, assuming that restrictive licensing of the kind described above is already in place. The crucial step is to convert the licences, or the supplementary licences to fish in particular zones, to licences that convey the right to take specified amounts (e.g., tons) of fish. If licences are for a fixed term, this would be done most conveniently when their term expires. Vessel licences might simply be replaced, and the annual catch authorized under each might be based on the vessel's catch during the preceding two or three years (this implies a reporting system before the change is made). Again, these rights to take specific quantities of fish could be divisible and transferable.

Holders of these quantitative rights can be expected to harvest their authorized catch at the least possible costs in order to maximize their profits, and so incentives to wastefully expand fishing power would no longer exist. Thus it would no longer be necessary to maintain the input limitation (on tonnage, or engine power or whatever had been limited under the earlier licences) and because such restrictions tend to impede technological efficiency they should be eliminated from the new licensing system.

A market can be expected to develop for these rights, and vessel owners can be expected to purchase and sell as they modernize and adjust their operations in search of efficient scale and technology. The regulatory authority can intervene in this market if it is necessary to increase or decrease the total allowable catch.

> CONCLUSION 9b. To establish a permanent policy framework for maintaining an efficient industrial organization, regulatory authorities should carefully examine the feasibility of converting vessel licences to quantitative rights.

In the present circumstances of most Mediterranean countries a serious obstacle to the introduction of such a management system would be the inadequacy of data on vessel landings. Indeed, not all fish pass through organized port markets. Clearly, a quantitative rights system requires a systematic and routine statistical recording of all landings, as can be found in certain North American and northern European fisheries. However, reliable catch statistics are needed for other management purposes as well, and can be collected with less difficulty for trawl fleets than for most other vessel types.

The collection of reliable data on landings can be facilitated by means of the modified scheme for allocating rights described in Part I. Under this arrangement, licensed rights would amount to less than the total allowable catch in normal years, the remainder to be allocated seasonally. These supplementary rights would vary in quantity, to bring the authorized catch up to the allowable catch determined for the current year. They could be sold at their market price, as information on stock conditions becomes available during the season. Moreover, some of these supplementary rights might be allocated to licensees without charge or at a preferred price. If each vessel owner's eligibility for these extra rights were determined as some percentage of his reported supplementary catch in the previous year, he would have a strong incentive to fully report his catch. This modification would also increase management flexibility, aid enforcement and generate revenue.

It should be apparent that quantitative rights not only discourage development of excess fleet capacity and inefficient technology, but also provide a direct and precise means of regulating the catch. The inherent incentives they create for operational efficiency means that there would be much less need, under such a system, to rely on taxes or royalties, or on "buy and retire" programmes, to reduce or contain the growth of fleet capacity. Regulation of yields is accomplished more directly under this system than any other, because the rights outstanding can be adjusted to the desired total allowable catch. Moreover, these arrangements afford a direct mechanism for managing the distribution of effort; under the area regulation framework suggested earlier (CONCLUSION 7), quantitative rights amounting to the total allowable catch could be issued for each area. Further complications such as mixed species or the need for seasonal controls, mentioned in Part I, may call for special modifications in particular cases. Finally, as explained earlier, such a system can incorporate annual fees for rights or royalties on landings to whatever degree it is considered desirable to capture the economic gains from rationalization.

10. Role of Fishermen's Organizations

One of the striking characteristics of certain Mediterranean fisheries is the well established organizations of fishermen; the Spanish Cofridías, the French Prud'homies, and some Italian cooperatives are notable examples. These associations have demonstrated their ability to play a useful role in organizing the affairs of fisheries, and it seems obvious that a regulatory policy would benefit from utilizing and developing these capabilities.

Especially when governments seek to change policies, such organizations can serve a valuable purpose as channels of communication with those most directly affected. In addition to communicating information, these channels promote reciprocal understanding of the problems of the regulatory authorities on the one hand and the regulated parties on the other, and thereby serve an educational function as well.

Some of these local organizations have shown their ability not only to manage their internal affairs but also to assist with information and advice. They have taken the initiative in seeking solutions to regulatory problems in some cases, and in Spain and France, for example, they have played an important role in enforcement.

Local organizations of fishermen can thus make a valuable contribution to a rationalization programme. Especially with the increasing need for control of the distribution of effort, their identification with particular ports and fishing grounds suggests a potentially useful mechanism for the management of yields by area. This is not the place to analyse the organization of fisheries administrations, but it is clear that some now lack a regional structure sufficient to deal with the special problems of particular fishing areas. However, where such regional offices exist, local and regional organizations of fishermen can complement and assist them with regional management.

There is much that governments can do to promote fishermen's organizations. As noted in Annex I, some Mediterranean countries have given them legal status, and in some cases membership is compulsory. They have substantial legislative and judicial authority in some cases. And, of course, governments can provide financial assistance in a variety of ways. The appropriate methods of encouraging these organizations will vary widely among countries.

> CONCLUSION 10. Governments should encourage development of strong, regional and local organizations of fishermen and vessel owners, and carefully explore opportunities for utilizing their talents and capabilities in managing regulatory programmes.

Some of the more sophisticated regulatory arrangements discussed above would gain considerably from the active participation of local fishermen's groups in the administration. A royalty system, for example, would benefit a great deal from the cooperation and data that local organizations can provide, and their contribution to the management of such a scheme would probably be strengthened if they shared the revenue. A system of quantitative rights, or vessel quotas, similarly offers scope for administration by local organizations. As in the case of the Bay of Fundy herring fishery in Canada, the local organization can usefully take much of the responsibility for administering catch quotas among participating fishermen and organizing their fishing activity, leaving the public authorities to concentrate on resource management and determination of the total allowable catch. In some cases it may become feasible simply to allocate the total allowable catch for particular areas to locally based organizations with authority to distribute the catch among their members. In any event, as regulatory programmes develop, the potential role of local organizations will be substantial, and their ability to participate constructively can be strengthened by governmental encouragement and support at an early stage.

Annex I

REGULATION OF FISHING CAPACITY AND EFFORT IN CERTAIN MEDITERRANEAN COUNTRIES

This Annex provides a review of the policies for regulating fishing effort and fleet development in six Mediterranean countries - France, Greece, Italy, Spain, Tunisia and Yugoslavia. These are among the most important Mediterranean fishing nations, and provide examples of a wide variety of political and industrial organization and of fishery conditions. Moreover, they include the nations that appear to have taken the most significant steps to control expansion of trawl fishing capacity.

The purpose of this review is to document the regulatory arrangements in each of these countries and to comment on their experience, in order to provide background and context for the general discussion of approaches to regulation in earlier parts of this report.

FRANCE

France's Mediterranean fisheries are very diverse, reflecting the wide variety of resources exploited in the northwestern part of the basin. The composition of the commercial fishery fleet is summarized in Table A.

Table A

Structure of France's Mediterranean fishing fleet

Vessel type	Number	Tonnage (GRT)	Total engine power (hp)
Bottom trawlers	215	5 885	46 737
Tuna seiners	45	1 150	8 506
Lobster boats	3	64	480
Multipurpose vessels	349	2 804	23 099
Small vessels (less than 10 GRT)	2 594	6 174	50 382

Source: Statistiques des pêches maritimes, Direction des pêches maritimes

For the last decade semi-pelagic trawling has been prohibited on the Mediterranean coast of France, and hence no such vessels appear in Table A; however, a few pelagic trawlers have recently been authorized. Of particular interest here is the bottom trawl fleet of 215 vessels. About 80 percent of the trawling off the Mediterranean coast of France takes place in the relatively shallow waters of the Gulf of Lions. Evidence suggests that there is little scope for increasing the catch in this region.

Administrative and Consultative Arrangements

The chief administrative officer for France's commercial fisheries is the Director of Fisheries, who reports to the Minister of Transport through the Merchant Marine Branch of the Ministry of Transport. The Director is responsible for the Office of Maritime Affairs which has four regional divisions (Directions), one being the Mediterranean with headquarters in Marseilles. The Mediterranean region is in turn divided for administrative purposes into eight sub-regions (Quartiers des affaires maritimes), each with five to ten offices (Stations maritimes).

Parallelling this administrative structure is an elaborate structure for consultation with representative groups involved in the fishing industry. The large Central Committee for Marine Fisheries (Comité central des pêches maritimes), based in Paris, is consulted on all major policy decisions affecting France's fisheries. Its some 80 members are formally appointed by the Minister, but are nominated by the syndicates representing fishermen, vessel owners, cooperatives and other groups. The full committee meets only about once per year, but its executive committee meets monthly. Supplementing the Central Committee is a number of Interprofessional Committees (Comités interprofessionnels) which consider problems relating to particular fisheries such as demersal fish, or sardines and anchovies, and these have sub-committees in each of the relevant regions. Although the public administration assists these interprofessional committees and poses problems for their consideration, they have the power to fix their own agendas and to initiate issues for deliberation.

In addition to the Central Committee structure, and with roughly corresponding membership, there is a Regional Fisheries Committee (Comité régional des pêches) for the Mediterranean and for each of the other three administrative regions. Reporting to these in turn are Local Committees (Comités locaux), one in each Quartier, with wide powers to consider local fishing problems. The important Local Committees refer their conclusions to the Regional and Central Committees only when they relate to matters beyond local concerns; on strictly local problems such as the length of the fishing week, their decisions become rules unless the administration disallows them. Not surprisingly in view of the varied interests represented in these committees, they often fail to reach a consensus; even then, they are regarded by the administration as valuable forums for consultation and discussion.

Membership in the Local Committees is compulsory for vessel owners. The committees levy fees on their members in order to finance their operations and to cover assessments passed on to them through the Regional Committees from the Central Committee to pay for such things as marketing campaigns and fishermen's welfare programmes.

The governmental agency responsible for intervening in markets, FIOM, is also represented on the Central Committee for Marine Fisheries. Among other things, this agency distributes subventions from the European Economic Community to local organizations, and administers governmental aid for vessel construction and improvement. Loans and grants for vessel construction are currently being phased out, however.

In the organization of France's fisheries, an important role is played by the Prud'homies. These follow an ancient tradition of fraternal organization of vessel owners in each port. One or more officers (Prud'hommes) are elected periodically to make decisions on a wide range of local fishing problems, including the regulation of fishing effort, and they have traditionally had legislative, enforcement and judicial functions.

Development of Controls on Effort

There is a very long history of self-regulation of fishing through the local Prud'homies. After the second world war, which had left the fishing fleets decimated, the government provided generous aid to those who had lost their vessels in order to rebuild fishing capacity. The stocks, having been for the most part unharvested during the war, produced large yields, and fishermen found that this resulted in depressed prices. Accordingly, the Prud'homies began to restrict fishing time, and in the late 1940s the prohibition of fishing at night became general.

About 1970, it became clear that additional controls were necessary. The pelagic and trawl fleets were expanding rapidly. Significant numbers of fishermen that had been based in Algeria moved to the coast of France; their vessels were typically bigger, more powerful, and capable of a longer range than the existing fleets, and so the established vessel owners began to upgrade their vessels in order to compete. Algerian vessels had engines with often double the 150 hp that had been established as the limit on the Mediterranean coast of France, and because the owners could not reasonably be required to replace them, the controls broke down and both engine and vessel sizes increased. Moreover, the creation of the European Economic Community provided an impetus to French fishermen to improve their production efficiency.

In the face of all these pressures, the Prud'homies pressed for governmental limitation of fishing power throughout the French Mediterranean. In 1972 the Central Committee for Marine Fisheries decided that the number and power of trawlers should be limited. Three years later, in 1975, this was endorsed by law; no more licences for trawlers would be issued, and their maximum power was fixed at 430 hp.

Today, in addition to these controls on vessel numbers and engine power, there are restrictions on fishing time which prohibit trawling at night and limit the fishing week to five days. There are also gear restrictions; most importantly, pelagic trawls and paired trawling have been normally forbidden since 1970, the Italian volante or chalut-boeuf having been considered too efficient. However, following the financial failure of the French light seining fleet, a few pelagic trawls have recently been authorized, but only when the applicant can guarantee a market for the catch as food. Significantly, at the large fishing port of Sète, since 1975 there have also been vessel quotas imposed on trawlers landing sardines, amounting to 500 kg daily. However, the purpose of this limit was to protect the position of the light seining fleet, and its function now is unclear.

Vessel Licensing

All commercial fishing vessels require a licence, which specifies only the general type of gear (for example, deep trawl). A licence authorizes fishing within any one of France's four administrative regions; a vessel licensed for the Mediterranean region is therefore entitled to fish anywhere along the Mediterranean coast of France. Licences carry indefinite terms and are issued without charge. They are appurtenant to the vessel, but they are transferable with the vessel and carry a significant market value.

Since 1972, no additional licences have been issued for the Mediterranean trawl fishery, so that a new vessel may be licensed only if it replaces a retiring vessel. A licence may be suspended or withdrawn if the owner is found guilty of infractions of fishing regulations.

In the opinion of the Ministry, a major shortcoming of the present regulatory arrangements is the lack of means to regulate fishing by area. Licences convey the right to fish anywhere in the Mediterranean, and because they are transferable with the vessels, fishing capacity can move from one port to another. Moreover, fishermen often find it advantageous to move to another area seasonally, or when the relative productivity of different fishing grounds changes. This unrestricted movement of vessels not only causes friction between the established fishermen in an area and newcomers, but also frustrates attempts to regulate the distribution of effort.

GREECE

The waters off Greece are less productive than some other parts of the Mediterranean sea because they are deep, distant from the Atlantic influence, and lack large river inflows. As Table 2 shows, Greece harvested 54.1 thousand t of Mediterranean fish in 1976, and this catch has been very stable over the preceding decade.

Nearly all fish landed by Greek vessels are marketed fresh, chilled or frozen for domestic consumption, and there is no significant processing industry. Per caput consumption of fish is high by Mediterranean standards, and imports, which greatly exceed exports, account for about one third of the supply.

Table B

Structure of the Greek fishing fleet
in the Mediterranean in 1977

Vessel type	Vessel size in GRT				Total number	Total GRT
	0-20	20-50	50-100	100-500		
Deep trawlers	49	217	67	26	359	15 916
Mixed trawlers and purse seiners	20	39	39	1	99	4 277
Purse seiners	166	158	12	0	336	7 551
Other seiners					839	n.a.
Small ringnets, trollers and others					1 812	n.a.
Inshore vessels:						
with motors (19 hp or less)					9 431	n.a.
unpowered					8 364	n.a.

Source: FAO preliminary unpublished statistics

The highly diversified Greek fleet in the Mediterranean is summarized in Table B. There is a very large number of small craft, many of which are without motors. These vessels fish with mixed gear along the mainland coast and off the numerous islands of the Greek archipelago. A large proportion of these vessels are owned by part-time, "amateur", and sport fishermen, who often do not produce fish for sale. The artisanal fishery plays a particularly important social role in Greece, providing employment and food in many remote areas where alternative sources of both are limited.

The midwater fleet consists of trawlers, seiners and vessels with mixed gear. Of the 458 trawlers and mixed trawlers and purse seiners, less than one third have a capacity exceeding 50 GRT or engines larger than 250 hp and about two thirds are older than 20 years. There are no pelagic trawlers, although some pelagic fish are caught by seiners for the food market.

In addition to this Mediterranean fleet, some 45 large Greek trawlers operate in the Atlantic, mainly off West Africa under agreements with coastal countries. The distant water fleet provides about one quarter of the total Greek catch. Another five percent is accounted for by Greece's important inland fisheries, where aquaculture is being successfully developed.

Information about the condition of stocks is rather meagre, although a survey programme is now underway. Fishing pressure is heavy on almost all of the coastal stocks of mullet, hake and other demersal species, and some are considered to be overfished. On the other hand, biologists expect that surveys may reveal opportunities for increased catches of deep water species, and there are substantial pelagic stocks of sardines and anchovies which have not so far brought sufficiently high prices to attract exploitation.

Administrative Structure and Fisheries Organization

The Fisheries Division of the Ministry of Agriculture is responsible for most fisheries administration. The Division, headed by a Director, maintains regional offices in about 18 major ports in addition to headquarters in Athens. Research is carried out by the Institute of Oceanographic and Fisheries Research, near Athens, which cooperates closely with the Fisheries Division but is formally under the Ministry of Coordination. The Greek Coast Guard is responsible for enforcement of fisheries regulations.

All fishing vessels are privately owned, and few owners own more than one vessel. Owners of trawlers (apart from those that operate distant water vessels) have no national organization, but there is a number of local groups. In contrast, all owners of purse seiners are members of an association which purchases the total catch of sardines at a uniform price and serves as a marketing agency. Fishermen have a well established union, although captains and engineers mostly belong to a separate organization which includes also seamen of the merchant marine. Crews of trawlers, for the most part, receive salaries, while those of purse seiners are paid on a share basis.

Fisheries Development and Regulation

The Government of Greece considers that the total capacity of the Greek fleet is already roughly sufficient to fully exploit the available resources. However, the fleet is considered to be in urgent need of modernization, and fishing effort is not well distributed among stocks and grounds. Accordingly, fisheries development policy is directed toward improving the economic performance of the industry by modernizing vessels, reorganizing the fleet and extending its range, while at the same time preventing expansion of sectors in which capacity is already sufficient. A related concern is to reduce dependence on imported labour; foreign workers, mainly from North Africa are now employed in considerable numbers as crew on larger vessels. In order to achieve a better distribution of efforts, to improve efficiency and to alleviate the need to import labour, the goal is to reduce the fleet to a smaller number of more modern and better equipped vessels with a wider range of operations.

A programme of subsidies for vessel construction and improvement is designed for these purposes. To assist the construction of new vessels of any type, and the modernization of old vessels, loans are provided under a plan administered by the Agricultural Bank subject to the approval of the Fisheries Division. A portion of such loans, amounting to not more than 20 percent of the cost of equipment installed, may be converted to a grant. However, because the total capacity of the trawl fleet is already considered sufficient, this grant may be increased to 20 percent of the total cost of a new trawler if the recipient retires an old trawler that he has owned for at least three years, and an even larger percentage grant may be obtained if more than one old vessel is retired.

Fishing operations are regulated by a considerable variety of restrictions on gear and fishing time and location. Conflicts among different types of gear are a serious problem, and have led to regulations to separate them. Thus purse seiners are restricted from fishing close to shore and beyond certain depths to prevent conflicts with inshore fishermen and trawlers. Trawlers also are prohibited from fishing close to shore, and in certain special areas. Trawlers operating at night are permitted a minimum mesh size of 14 mm, while daytime trawlers (which normally operate in more distant and deeper waters) are allowed a minimum mesh size of 18 mm.

There is no restriction on trawling at night, and trawlers operate every day of the week. However, primarily to protect young fish, trawling is subject to a closed season of four months, extending from June to September (inclusive), and other closed seasons apply to particular areas.

Vessel Licensing

All fishing vessels must be licensed. The licences specify the type of gear to be used on the vessel, and many vessels are licensed for more than one type of gear. Among the latter are the mixed trawlers and purse seiners referred to in Table B. Licences are issued without charge, and carry terms of two years. Vessels, with their licences, are transferable without restriction.

The licensing system, like the subsidy arrangements, is designed to encourage fleet modernization while controlling expansion of capacity. To qualify for a licence, vessels must meet minimum specifications relating to size of engine power and other characteristics; trawlers, for example, must have (among other things) a keel length of at least 14 m and engines of at least 80 hp. There are no upper limits on vessel size or power. These requirements apply to all new vessels, but existing vessels that do not meet these standards are nevertheless given licences until they are retired. The minimum standards for a licence are less stringent than the qualifications for assistance for vessel construction and improvement mentioned earlier. To obtain a licence for a new vessel, the applicant must have been an established fisherman for at least 10 years and he must build a vessel that meets the approval of the Ministry.

These policies reflect the objective of the Greek Government to modernize and extend the range of the fishing fleet. At the same time, they reflect a concern to control expansion of fishing capacity, especially in the trawl fleet, which is considered to be already sufficient to fully exploit the available stocks.

ITALY

Italy's large and complicated fishing industry is based in hundreds of ports along the country's long coastline which are connected to a highly fragmented marketing system. The Italian catch of Mediterranean fish is larger than that of any other country, as Table 2 indicates. Italy's reported harvest of 357 000 t in 1976 was more than double that of Spain and nearly eight times that of France. Moreover, this figure is believed to be considerably less than the total catch, because many landings do not pass through established markets and are therefore not recorded. A small fraction of Italy's total landings is caught in the Atlantic.

In spite of this relatively large catch, and a modest per caput consumption of fish by European standards, Italy depends heavily on imports of fish, and on imported food generally. In recent years Italy imported more than half of its fish requirements (in live weight equivalent). Most of Italy's Mediterranean catch is marketed fresh or chilled for domestic consumption, although pelagic species such as sardines and anchovies are largely exported.

The structure of the Italian commercial fleet, which is the largest in the Mediterranean, is summarized in Table C. There are large numbers of vessels of all major types, including a great many small inshore boats, often without motors that comprise Italy's extensive artisanal fishery. The substantial fleet of trawlers includes both bottom trawlers and pelagic (volante) trawlers. Not included in these figures are twenty Italian distant water vessels fishing in the Atlantic.

Table C

Structure of the Italian fishing fleet in 1978

Vessel type	Vessel size in GRT					More than 500	Total number	Total GRT
	Less than 25	25-50	50-100	100-150	150-500			
Trawlers	3 035	1 160	473	184	97	46	5 265	198 335
Purse seiners	996	108	25	7	7		1 143	14 662
Trollers and trammel nets	8 536	25	1	1			8 563	27 112
Mixed gear	4 346	158	40	14	4		4 562	29 024
Other powered vessels	2 806	27	7	2	2	10	2 854	23 032
Unpowered vessels							20 371	n.a.

Source: FAO preliminary unpublished statistics

Because of Italy's heavy dependence on imported fish, the Government has given priority to the development of fishing capacity in order to utilize the stocks off the Italian coasts. However, there now appears to be little scope for expanding the catch of inshore and demersal stocks, and some stocks have been overexploited. Most pelagic stocks are believed to be capable of increased yields, however.

Administrative and Consultative Arrangements

Governmental responsibility for the management of Italy's fisheries rests with the Ministry of Merchant Marine (Ministero della Marina Mercantile). For administrative purposes the coast is divided into 45 districts (compartimenti), most of which are further subdivided into local administrative units (uffici locali marittimi; delegazioni di spiaggia). The district offices (Capitanerie) are directly responsible to the Ministry. Each district hosts a local commission for maritime fisheries (Commissione Locale Pesca Marittima) which has statutory consultative authority over certain fisheries matters of local concern.

The Ministry receives advice, and is provided with a mechanism for consultation with representative groups in the industry, through the Central Committee for Maritime Fisheries (Commissione Consultativa Centrale Pesca Marittima). In the major fishing ports, fishermen are organized into cooperatives which provide services and support to their members, and as explained below, some play an important role in regulating fishing activity as well. These cooperatives vary considerably in size and sophistication.

Government Influence on Expansion of Fishing Capacity

Following the second world war, which had left the Italian fleet largely devastated, the Government introduced a programme of subsidies for vessel construction in an effort to rebuild the country's fishing industry. Generous assistance in the form of grants and low interest loans was provided under a series of enactments, and resulted in the present substantial fleet of trawlers of various types.

The Italian fleet now appears to have reached an aggregate capacity that is capable of fully exploiting the available stock. Consequently, the programme of general assistance for vessel construction is being phased out, and is being replaced by assistance for improving and modernizing existing vessels. Current trends include increasing engine power in trawlers, and replacement of older trawlers with more modern vessels.

The Ministry of Merchant Marine is currently designing new legislation in consultation with representative groups in the fishing industry. Among other things, it will probably provide, instead of general assistance for fleet expansion, administrative authority to direct aid to particular sectors of the primary or secondary industries which are deemed to offer scope for development. It is expected, also, that aid for construction of new vessels will be restricted to loans, and will be available only on the condition that existing vessels, of a tonnage roughly equal to the vessels to be constructed, be retired.

The Ministry expects that because of the high capital costs of vessel construction, the withdrawal of financial aid for additional vessels will be sufficient to forestall further expansion of the semi-industrial fleet. However, certain stocks, mainly the small pelagic species such as sardines and anchovies, are capable of yielding increased harvests. The Ministry plans to pursue these opportunities by promoting domestic consumer demand, a policy which has already proven effective. Importantly, the change in gear required to switch from the heavily exploited demersal stocks to these small pelagic species is relatively simple. In short, Italy's policy continues to promote the fishing industry, but it is shifting from general assistance for expansion of fishing capacity to a more discriminating programme of industrial and market development to reconcile production with market demands and available resources.

The policies of the European Economic Community are having an impact on Italy's fisheries development in two important respects. First, recent EEC regulations have had the effect of encouraging increased trawling for pelagic species, mainly sardines and anchovies. In the past, Italian fishermen engaged in pelagic fishing sold their catch almost entirely in the domestic fresh food market, and local cooperatives regulated the number of pelagic trawlers to reconcile the catch with market demand of the ports. Under new EEC provisions aimed at stabilizing prices, any catch surplus to that demand is directed to fish meal production, where members of recognized producer associations are eligible for a subsidy that

brings the floor price up to a reference level based on the food fish price. As a result, in spite of Italy's general policy to reduce its dependence on food imports, and in particular to develop domestic consumer demand for the larger catches of pelagic fish available, the fishermen's organizations no longer have incentives to further promote markets and distribution channels for fresh fish as they have done in the past. Nor do fishermen have an incentive to take the extra care in handling fish that is necessary to serve the food market.

Second, the EEC has been considering proposals for a programme of governmental purchase and retirement of fishing vessels to reduce excess fishing capacity. So far, these proposals have not been accepted by the European Parliament. Italy plans to postpone national measures of this kind until the EEC policy is resolved.

Cooperative Controls

In seeking to influence the growth of Italy's fisheries, the Government has thus depended mainly on subsidies and financial incentives. The major attempt to directly control the deployment of fishing effort has been on the part of certain fishing cooperatives, which have voluntarily undertaken to restrict the fishing time of their trawl fleets. These measures have been encouraged by the Ministry, but they have not had the sanction of legislation.

The interesting history of this cooperative action began during the late 1960s, when fishermen on the central Adriatic coast began to experience a decline in trawl catches. Scientists at the newly established fisheries research laboratory at Ancona assisted, through lengthy discussion and debate with fishermen's groups, in bringing about an understanding that fishing effort was becoming excessive, and that some means of curtailing effort was needed to restore and maintain catches. After prolonged debate, and although fishermen remained divided on both the cause of their problem and the means of solving it, it was decided in 1973 that the trawlers of certain cooperatives on the Adriatic coast would, as an experiment, shorten their fishing week by returning to port on Friday night, rather than on Saturday night which was the traditional practice.

The feared decline in earnings did not occur; prices rose somewhat, but more importantly the total catch began to increase significantly after only a few months. In any event, Saturday catches had usually brought lower prices than fish landed earlier in the week. Two other factors contributed to the success of the experiment. The first was technical; since demersal fish tend to become dispersed, and hence the catch per unit of effort declines under continuous fishing, the shorter fishing week and longer break raised the productivity of effort. The second was social; fishermen especially welcomed the longer weekend in port. Indeed, they soon succeeded in pressing for a return to port on Friday morning, rather than Friday evening.

The success of the shorter fishing week led, in 1976, to a decision to stop fishing yet earlier, on Thursday evenings. Since then, the fishing week has been maintained at four days, or more precisely 84 h, from Monday morning to Thursday afternoon (with extensions in cases of interruptions caused by bad weather). The demonstrable economic and social benefits of the restraints have generated a broad support for them among the participating fishermen. However, the measures described here were taken by certain cooperatives on the Adriatic coast; elsewhere there has been little or no attempt to control fishing effort.

It should be noted that, although restoration of catches was a major objective of these measures, other considerations also influenced the cooperatives in their choice of methods to reduce fishing pressure. One was to create a fishing regime that would allow fishermen a regular weekly opportunity to effect repairs to their vessels; previously, inadequate time for these purposes often resulted in either poor maintenance or loss of regular fishing time. Second, it was considered important to enable fishermen to participate more fully in the life of the ports and to create a work environment attractive to young men, by providing increased time in port. Third, in the face of recent dramatic increases in price for the large quantities of diesel fuel consumed by trawlers, there was a deliberate attempt to reduce fuel requirements by curtailing fishing and running time.

While the cooperative restrictions on fishing time appear to have served these varied objectives, there does not appear to be much scope for further shortening of the fishing week. For one thing, an interruption in the supply of fish of more than three days would create severe problems in fish marketing. For another, it is questionable whether any further reduction in fishing effort would, in itself, lead to yet higher catches or productivity. Finally, and most importantly from an economic point of view, while the shortening of the weekly period at sea from the onerous traditional practice appears to have been both contributory to economic efficiency and consistent with the general improvement in industrial working conditions, much further restriction of fishing time will inevitably result in involuntary underemployment and waste of labour and capital.

Another fundamental limitation of these measures results from the fact that they are the voluntary actions of certain local fishermen's cooperatives and hence cannot be enforced on outsiders. In these circumstances, success in significantly increasing fishermen's incomes and the profitability of fishing in a particular region will threaten to attract fishing enterprises from elsewhere and thereby frustrate the control effort. In the long run, increases in fish prices or continuing technological advances that can lower the cost of harvesting fish are likely to offer scope for improving the returns to fishing, but without official regulation of access it may not be possible to realize these potential gains. Not surprisingly, there is growing support within the cooperatives for governmental restrictions on entry not only of fishermen (which has already been proposed) but also of vessels.

Governmental Regulation

All Italian fishing vessels must be licensed. Large vessels require a licence that is issued for an unlimited term, subject to an annual fee. Small inshore vessels must carry a permit (piccola pesca) which specifies the particular gear to be used. There is no general limitation on the number of licences issued.

Apart from certain restrictions on gear, there is little official regulation of fishing effort in Italy. However, as this report was being written, a significant policy innovation was implemented for the relatively small clam fishery (Venus gallina). A few years ago, technological developments in mechanical dredges and hydraulic pumps led to a sudden conversion of a small artisanal fishery into a profitable mechanized industry serving mainly export markets. Harvesting capacity quickly became excessive, and following a dramatic increase, yields began to decline. Through their cooperative, the fishermen appealed to the Ministry, which responded by imposing a regulatory system in 1979. Under a provision of the fisheries regulations that applies to artisanal fishermen, the Ministry froze the number of permits for clam fishing. In addition, the local Capitanerie were authorized to restrict each permit holder to a particular district (compartimento) and to limit the catch of each. In effect, the new arrangements combine an individual fisherman's quota with an area management system. The approach thus appears very promising, but it is obviously too early to judge its effectiveness or whether it will become a precedent for other fisheries.

SPAIN

Spain is one of Europe's largest fishing nations, but only a small fraction of total landings is caught in the Mediterranean. Nevertheless, Spain's Mediterranean catch is second only to that of Italy. The Spanish Mediterranean fleet is large and diverse. In 1977, it consisted of 1 145 deep trawlers, 482 light seiners, and about 4 000 small vessels. As in France, pelagic trawls have been prohibited, and so there are no vessels of this type. The average vessel in the large fleet of trawlers is 41 GRT, has an engine power of 225 hp and carries a crew of six. Some of these trawlers occasionally switch to seine gear.

The large and modern Spanish fleets range widely in the Atlantic as well as the Mediterranean, with annual landings in the order of 1.5 million t valued at US$ 1 000 million in 1975. Most of the catch is marketed fresh or chilled for domestic consumption, although exports substantially exceed imports. The per caput consumption of fish in Spain is among the highest in Europe.

Generally, the stocks off the Mediterranean coast of Spain are heavily exploited. Demersal stocks especially, and particularly in the region of Castillón, appear to be overfished, and some increase in yields could be expected from a reduction in fishing pressure (Astudillo et al, 1978; Levi and Troadec, 1974).

Administrative and Consultative Arrangements

The principal administrative agency is the Bureau of Fisheries (Dirección Generale de Pesca) which is centralized in Madrid. Until recently, the Bureau was responsible to both the Ministry of Commerce and the Ministry of Merchant Marine, but it is now a division of the Ministry of Transport. The Bureau has no regional structure; local administration is in the hands of the port authorities of the Spanish navy.

To provide the administration with means for consulting the various interest groups in the fishing industry, there is a Central Fisheries Commission (Junta General de Pesca). In addition, there are three autonomous regional Commissions, two on the Atlantic coast and one on the Mediterranean, the latter being the most active. The secretary of the Mediterranean Commission, who presides at its monthly meetings, is a representative of the Bureau of Fisheries, and the membership of the Commission includes representatives of fishermen from each coastal province, port authorities, scientists, and certain other Ministries. Fishermen are represented also on the Commission's technical subcommittee.

For many centuries, fishermen in Spanish ports have been organized through local fraternal associations called Cofradías (Cofradías de Pescadores). There are now some 60 ports on Spain's Mediterranean coast, each of which has a Cofradía. Although membership is not compulsory, all fishermen, both vessel owners and crew, join to take advantage of the services and benefits provided by the Cofradías. The management of these organizations is equally divided between vessel owners and crew. The Cofradías play an important role in regulating fishing, in organizing the sale of the catch at port, and in providing a wide range of other services to their members. In some cases they have assumed the functions of local fishermen's cooperatives.

A law passed in 1978 gives the Cofradías legal status and codifies their organization and functions. It is expected that their officers will in future be paid by the Government. There already exists a national federation of Cofradías, and plans are being made for regional organization as well.

Development of Regulatory Measures

The present structure of controls on fishing is of recent origin. Some years following the second world war, fishermen in the Spanish Mediterranean began to experience declining catches, and under pressure from scientists and the Cofradías, an informal commission was established to help deal with the problem.

In 1961, after much deliberation, a five-year "Experimental Plan" of fisheries rehabilitation was adopted for an area of coastal waters extending from the mouth of the Ebro River to the southern boundary of the province of Castillón, an area in which the profitability of fishing had declined markedly. Under the Experimental Plan, the fishermen, the administration and scientists cooperated on a number of voluntary controls on trawl fishing. First, a closed season of three months on fishing for hake and Gadus capilanus (which, with red mullets, are the three main species of demersal catch) was introduced. Later, during the last two years of the plan, this closure was reduced to two months. Second, the legal minimum mesh size of 18 mm (=36 stretched), which had hitherto been poorly enforced, was adopted for the first three years, and in light of its success in raising the average size of fish, was increased to 20 mm (=40 mm stretched) when the closed season was shortened. Third, a closed area was introduced from August to November, when this species migrates inshore to spawn. Fourth, two limitations on fishing time were adopted. The daily fishing time was reduced to 12 or 14 h and later to as few as 10 h; this control was administered flexibly to prevent overloading the market, especially when catches were large at the beginning of the fishing season. And fishing on Saturday (which in any event brought relatively low prices when the catch was sold on Monday) was closed. Initially, the Saturday closure was compensated by two extra hours fishing on Friday, but fishermen soon pressed for elimination of this additional Friday fishing.

To enforce these controls, certain vessels were hired to monitor fishing, and for this purpose patrolled with an officer of the port authorities on board. Enforcement was strict; the Cofradías were empowered to levy fines on fishermen found guilty of offences, and to direct the revenues toward financing the control programme.

It should be noted that the commission had regarded the measures taken under the Experimental Plan as means of mitigating a situation of severe economic decline, in the face of inaction on the part of the central fisheries administration. The controls were considered highly successful, not only with respect to improved earnings, but also in terms of a more desirable work regime for fishermen (Suau, 1967).

Consequently, when the Experimental Plan ended in 1966, pressure mounted to replace it with official and more general controls on the Spanish Mediterranean. In 1970, the Mediterranean Fisheries Commission was officially created and its secretariat toured the ports to provide information and to survey the attitudes of fishermen. This had the effect of encouraging the Cofradías to unify somewhat their policies on fishing time, in the few areas where they had independently undertaken to regulate this dimension of fishing effort. More importantly, this tour initiated a vigorous debate on the desirability of controls on fleet expansion.

Vessel owners anticipating the introduction of governmental restrictions, reacted by investing heavily in fishing power. Between 1971 and 1975, the number of trawlers increased from 1 086 to 1 125, their average tonnage rose by one third and their average engine power increased by about 40 percent (FAO, 1978a).

Finally, a Ministerial Order gave legal status to controls on trawl fishing in 1975. All Mediterranean fisheries were restricted to a maximum of five days fishing per week, and except in special cases, a maximum of 16 h per day out of port (determined in such a way as to maximize the possible daylight hours). The local Cofradías were directed to fix, from time to time, the precise fishing hours, which are then officially endorsed by Ministerial Order. Finally, further increase in the number of trawl vessels was arrested through the vessel licensing system.

Vessel Licensing

A system of vessel licences was already in place for registration and administration purposes. The trawl fleet was restricted to its 1975 number by the Bureau of Fisheries' refusal to issue any additional licences. A new vessel could be introduced only if another vessel or vessels of equivalent engine power were retired. In effect, then, it is the aggregate horsepower of the fleet that is restricted (but unlike France, the engine power of individual vessels is not limited).

Licences are issued by the Bureau of Fisheries without charge. They are appurtenant to the vessel and are transferable with the vessel. A licence provides the right to fish with a general type of gear and a specified engine power. It is indefinite in term, although it may be forfeited if the vessel leaves the Mediterranean for more than six months.

The Ministry is instructed to specify, every two years at least the rules for allocating fishing licences and other means of regulating the fishery effort. At present, vessels licensed for trawling may also fish with seines (although vessels licensed for seining are not eligible to trawl); and while vessels licensed for the Mediterranean may fish elsewhere, other vessels may not fish in the Spanish Mediterranean. There are two exceptions to the rule that a new licence will be issued only if equal horsepower is retired; a new vessel may be introduced by a member of an established family of fishermen without retiring any other vessel, and a cooperative may do so if it retires less than equivalent engine power.

Thus the controls on trawling effort consist of regulations on fishing time (the time of day and the number of days per week; there is no closed season), and a limitation on aggregate engine power, which in 1977 amounted to 257 106 hp. Engine power is determined for each vessel according to a formula based on engine displacement and rpm. The formula has, incidentally, been a cause of complaint among vessel owners with single cylinder semi-diesel, low rpm engines who have wanted to convert to full diesel motors which produce less power in relation to engine size. There has been no perceptible trend in the number of trawlers since this limitation has been in effect.

The present capacity of the trawl fleet is considerably greater than that considered necessary to fully exploit the stocks, perhaps three times the required capacity. During the oil crisis of 1974, the Government moved to subsidize the price of fuel, but on the suggestion of Mediterranean Fisheries Commission, it undertook instead, to use the funds to purchase and retire vessels, thereby reducing both fuel consumption and fishing capacity. However, the price offered for vessels was apparently unattractive to vessel owners, and in spite of the support of the Commission this "buy and retire" venture failed.

The substantial expansion of engine power that occurred in the years preceding 1975 had the effect of broadening the range of the fleet to grounds that were not previously fully exploited. However, the new restrictions on fishing hours per day constrain distant fishing. For this, and other reasons, the Commission sees a need for a more regionalized administrative organization and for regional controls on fishing activity.

TUNISIA

Tunisia's catch from the Mediterranean Sea is considerably less than that of the European countries, but its reported landings of 35.4 thousand t in 1976 is among the largest of the North African states. Moreover, as Table 2 indicates, the Tunisian catch has been increasing very rapidly in recent years.

The organizational structure of the fishing industry in Tunisia differs from that of the other countries discussed in this report insofar as it consists of three sectors: the state, cooperative and independent private sectors. The state sector, administered by the National Fisheries Office (Office national des pêches) is the largest and most diverse. It includes most types of fishing, aquaculture, wholesale marketing, processing, vessel construction, gear manufacturing and distribution and services. Some of the latter activities service the non-state sectors as well. With respect to fishing, Table D shows that the state sector operates about one quarter of Tunisia's trawl fleet, and a few tuna vessels (thonniers) and light seiners (lamparos). In addition, it operates all of the standing traps for tuna as well as those in lagoons and lakes.

The cooperative sector consists of private fishing enterprises, processors and distributors organized under port cooperatives. Cooperatives provide gear, credit, marketing assistance and other services to members. Although this is the smallest sector, it is expanding rapidly, and within another year it is expected that there will be a cooperative in each significant port. Although the number of vessels operated by the cooperative sector is not distinguished from that of the independent private sectors in Table D, the cooperatives account for most of the private trawlers and a relatively small proportion of the light seiners and other vessel types. Most of the inshore fleet and light seine operations comprise the unorganized private sector.

About one third of the trawl vessels are equipped with motors greater than 300 hp. Some trawlers engage in deep trawling during the winter only, switching to other gear such as light seines or pelagic trawls in the summer months. A few of the larger private fishing enterprises in Tunisia operate several trawlers each.

Table D

Structure of the Tunisian fishing fleet in 1978

Vessel type	State sector	Cooperative and independent private sectors	Total
Trawlers	56	158	214
Tuna vessels	2	4	6
Light seiners	4	208	212
Inshore vessels	0	5 722	5 722
TOTAL	62	6 092	6 154

Source: Direction des pêches, Tunis

Administrative and Consultative Arrangements

Tunisia's fisheries administration is currently being reorganized. To consolidate responsibility for fisheries matters which had previously been divided among several Ministries, a Fisheries Commissariat (Commissariat général de la pêche) was created in 1979. This new agency, under a Director General (Président Directeur général), is responsible for the operations of the National Fisheries Office as well as general fisheries administration.

Tunisia's political system includes regional governmental structures with a Governor who represents the President in each region. There are some 10 coastal regions, most of which have several ports, one or two of which serve as ports for trawlers. When the new fisheries administration is fully in place, there will be an office of the Commissariat, under a Port Chief, responsible for fisheries matters in each region.

Consultative arrangements are provided by a Regional Fisheries Council in each region. The membership of these Councils includes Port Chiefs, representatives of fishermen and cooperatives and other interested parties such as processors, shipyard owners, and researchers where there exists a research centre in the region. These Councils meet to discuss fisheries problems three or four times a year under the chairmanship of the Governor or his representative.

Fisheries Development and Regulation

Apart from the heavily exploited inshore demersal stocks, the fish resources off the Tunisian coast are generally believed to offer scope for expanded harvests, and a preliminary survey suggests that the catch of pelagic species can be increased substantially. Accordingly, fisheries expansion has been accorded high priority in Tunisia's economic planning, and has an important place in the current five-year plan which runs to 1981. At the same time, increasing difficulty has been experienced in maintaining the fishing labour force, and a major objective is therefore to improve employment opportunities in the fisheries. The Government encourages development in all sectors, not only through manpower training programmes, but also through both direct investment in the state sector and financial aid for private investment in vessels. For construction of new trawlers and inshore vessels, an owner can receive a grant of 15 percent of the cost and a low interest (6 percent) loan of 75 percent. This aid has been partially supported under programmes of the World Bank; the second of these, which has recently begun, emphasizes development of inshore fisheries through assistance for vessels, small harbours and training. Additional programmes are being formulated to encourage development of the trawl fleet.

Trawl fishing in Tunisia is subject to a variety of controls. In addition to the 20 mm minimum mesh size and a prohibition on trawling within 3 mi of shore and in waters less than 50 m deep, fishing is prohibited in nursery grounds such as the Gulf of Gabès and seasonally restricted in areas that are believed to be overfished, such as the Gulf of Tunis. There is no general restriction on fishing time, but by tradition there is no fishing at night except light seining.

Of particular interest in Tunisia's system of vessel licensing, which is currently being revised to enable control over (among other things) the distribution of fishing effort. All vessels must be licensed; a requirement that has been in effect for many years. These licences, administered by the Port Chiefs, must be renewed annually for a nominal charge. Under Legislation to take effect in January 1980, licences will stipulate in greater detail the conditions under which the vessel is authorized to fish; in addition to specifying the owner, the dimensions and power of the vessel and the type of gear to be used, each licence will authorize fishing in a particular zone. For this purpose, the waters off Tunisia will be divided into several zones, and new licences will be issued for a particular zone (or transfers from another zone approved) only if that zone is considered to offer scope for increased catches. Moreover, an owner who wishes to increase the power of his vessel or otherwise alter its licensed characteristics must apply for an amendment to his licence which will similarly be granted only if the zone in which he is authorized to fish is not already fully exploited.

These innovations are designed to ameliorate the imbalance between potential yields and fishing effort in various fishing areas, a problem that is evident in many other Mediterranean regions as well. Significantly, this unique mechanism for regulating the distribution of effort is expected to be well within the administrative and enforcement capabilities of Tunisia's fisheries administration.

The licences are specific to particular vessels, and therefore cannot be transferred from one vessel to another. Moreover, transfers of ownership of vessels is also closely controlled through the licensing system. Generally, transfers are approved only when the buyers are already established members of the fishing community.

YUGOSLAVIA

Yugoslavia's catch in the Mediterranean is the smallest among the European countries discussed in this report; as Table 2 indicates, its increase during the last decade has been modest. Hitherto, the markets for fish have been mainly along the coast, with little tradition of fish consumption in the interior. However, with recent improvements in distribution and marketing facilities, demand has been increasing throughout the country, and Yugoslavia now imports significant quantities of fish.

The structure of Yugoslavia's fishing fleet in 1977 is summarized in Table E. The relatively stable catch is a reflection of a low rate of growth and modernization of the fleet during the last decade. However, as a result of increasing domestic demand for fish, depressed export markets for meat in the face of new EEC restrictions, and apparent scope for expansion in fish yields, fishery development has been accorded a much higher priority in Yugoslavia's current five-year economic plan. Few stocks off the coast of Yugoslavia show signs of overfishing so far except for certain demersal species in the channels among the coastal islands. Especially the pelagic stocks of sardines and anchovies (which are exploited also by the Italian Adriatic fleet) are believed to be capable of expanded yields. At present, only one enterprise operates a few pelagic trawlers.

Table E

Structure of Yugoslavia's fishing fleet in 1977

Vessel size GRT	Number	Total GRT
50 +	40	3 101
10 - 50	166	4 509
Small vessels		
powered	8 170	n.a.
unpowered	1 582	n.a.
TOTAL	9 958	n.a.

Source: FAO preliminary unpublished statistics

Fisheries Organization and Administration

Yugoslavia's political organization provides a large degree of decentralization of authority among the composite republics. The four coastal republics of Croatia, Slovenia, Monte Negro and Bosnia are involved in fishing, and of these Croatia accounts for roughly three quarters of the national catch. Although there is a fisheries section in the national Ministry of Agriculture, most of the direct responsibility for fisheries administration rests with the Governments of these regional republics. In each, a Vice-Secretary for Fisheries is responsible to the Secretary for Agriculture. Local administration is provided by fisheries inspectors, who are responsible for fisheries matters in districts that consist of one or more coastal municipalities.

Kaczynski, W., Responses and adjustments of foreign fleets to controls imposed by coastal
1979 nations. J.Fish.Res.Board Can., 36(7):800-10

Keen, E., Fishery rights and the 200-mile zone: the tragedy of a mal-stinted commons.
1974 NOAA Tech.Rep.NMFS Circ., (371):146-58

Larkin, P.A., An epitaph for the concept of maximum sustained yield.
1977 Trans.Am.Fish.Soc., 106:1-11

Levi, D. et J.-P. Troadec, Les ressources halieutiques de la Méditerranée et de la mer Noire.
1974 Etud.Rev.CGPM/Stud.Rev.GFCM, (54):29-52

Levi, D. and J.-P. Troadec, The fish resources of the Mediterranean and Black Sea. Etud.
1974 Rev.CGPM/Stud.Rev.GFCM, (54):29-52

McConnel, K.E. and V.J. Norton, An evaluation of limited entry and alternative approaches to fishery management. In Proceedings of Workshop on Limited Entry. Seattle, University of Washington (in press)

McKellar, N.B., Restrictive licensing as a fisheries management tool. FERU Occas.Pap.Ser.,
1977 (6):55 p.

MacKenzie, W.C., Rational fishery management in a depressed region: the Atlantic ground
1979 fishery. J.Fish.Res.Board Can., 36(7):811-26

Meany, T.F., License limitation in a multi-purpose fishery. Aust.Fish., 19:8-11
1977

_____, Limited entry in the Western Australian rock lobster and prawn fisheries: an
1979 economic evaluation. J.Fish.Res.Board Can., 36(7):789-98

Moloney, D.G. and P.H. Pearse, Quantitative rights as an instrument for regulating commercial
1979 fisheries. J.Fish.Res.Board Can., 36(7):859-66

Montgomery, W.D., Markets in licenses and efficient pollution control programs. J.Econ.
1972 Theor., 5:395-418

Paterson, D.G. and J.E. Wilen, Depletion and diplomacy: The North Pacific seal hunt 1880-1910.
1977 In Research in economic history, edited by P. Usleding, Greenwich, Conn., J.A.I. Press, vol.2

Pearse, P.H., National regulation of fisheries. Ottawa, Department of the Environment,
1971 Fisheries and Marine Service (mimeo)

_____, Rationalisation of Canada's west coast salmon fishery: an economic evaluation.
1972 In Economic aspects of fish production. Paris, OECD, pp. 172-202

_____, Méthodes de régulation économique de la pêche/Approaches to economic regulation
1978 of fisheries. Document présenté au Stage ACDI/FAO/COPACE sur la planification du développement et l'aménagement des pêches. Lomé, Togo, 6-17 février, 1978, Doc. 10:31 p. (mimeo)

_____, Méthodes de régulation économique de la pêche/Approaches to economic regulation
1978 of fisheries. Paper presented to the CIDA/FAO/CECAF Workshop on Fishery Development Planning and Management. Lomé, Togo, February 6-17, 1978, Doc.10:31 p. (mimeo)

_____, Property rights and regulation of commercial fisheries. J.Bus.Admin., vol. for
1979 1979

_____, (ed.) Symposium on policies for economic rationalization of commercial fisheries.
1979a J.Fish.Res.Board Can., 36(7):711-867

Pearse, P.H. and J.E. Wilen, Impact of Canada's Pacific salmon fleet control program.
1979 J.Fish.Res.Board Can., 36(7):764-9

Pontecorvo, G., D.M. Johnston and M. Wilkinson, Conditions for effective fisheries management
1977 in the Northwest Atlantic. In Economic impacts of extended fisheries jurisdiction, edited by L.G. Anderson, Ann Arbor, Mich., Ann Arbor Science Publishers, pp. 51-103

Randall, A., Property rights and social microeconomics. Nat.Resour.J., 15:729-47
1975

Royce, W.F., et al., Salmon gear limitation in northern Washington waters. Univ.Wash.Publ.
1963 Fish., 2(1):123 p.

Sanders, M.J., The State view of licence limitations. Aust.Fish., 34:116-24
1975

Schaefer, M.B., Some considerations of population dynamics and economics in relation to
1957 management of the commercial marine fisheries. J.Fish.Res.Board Can., 14(5): 669-81

Scott, A.D., The fishery: the objectives of sole ownership. J.Polit.Econ., 63:116-24
1955

_____, Optimal utilization and the control of fisheries. In The economics of fisheries,
1957 edited by R. Turvey and J. Wiseman, Rome, FAO, pp. 42-56

_____, The economics of regulating fisheries. FAO Fish.Rep., (5):25-61
1962

_____ (ed.), Economics of fisheries management: a Symposium. H.R. Macmillan lectures
1970 in fisheries. Vancouver, University of British Columbia

_____, Development of economic theory on fisheries regulation. J.Fish.Res.Board Can.,
1979 36(7):725-41

Sinclair, S., A licensing and fee system for the coastal fisheries of British Columbia.
1978 Vancouver, Department of Fisheries and Oceans of Canada

Sinclair, W.F., Management alternatives and stategic planning for Canada's fisheries.
1978 J.Fish.Res.Board Can., 35(7):1017-30

Sissenwine, M.P., Is MSY an adequate foundation for optimum yield? Fisheries, 3:22-42
1978

Smith, V.L., Economics of production from natural resources. Am.Econ.Rev., 58:409-31
1968

_____, On models of commercial fishing. J.Polit.Econ., 77:181-98
1969

Southey, C. and A.D. Scott, The problems of achieving efficient regulation of a fishery.
1970 In Economics of fishery management: a Symposium, edited by A.D. Scott. Vancouver, University of British Columbia, pp. 47-59

Suau, P., El plan experimental de pesca de arrastre al final de su vigencia. Publ.Téc.
1967 Junta Estud.Pesca, Madrid, (6):175-86

Troadec, J.-P., Les objectifs de l'aménagement/The objectives of management. Document pré-
1978 senté au Stage ACDI/FAO/COPACE sur la planification du développement et l'aménagement des pêches. Lomé, Togo, 6-17 février, 1978, Doc. 7:26 p. (mimeo)

Troadec, J.-P., Les objectifs de l'aménagement/The objectives of management. Paper presented
1978 to the CIDA/FAO/CECAF Workshop on Fishery Development Planning and Management. Lomé, Togo, February 6-17, 1978, Doc. 7:26 p. (mimeo)

Turvey, R., Optimization and suboptimization in fishery regulation. Am.Econ.Rev., 54:64-76
1964

Turvey, R. and J. Wiseman (eds), The economics of fisheries. Rome, FAO, 234 p.
1956

Walters, C., Optimal harvest policies for salmon in relation to environmental variability
1975 and uncertain production parameters. J.Fish.Res.Board Can., 32(10):1777-84

Wilen, J., Fisherman behaviour and the design of efficient fisheries regulation programs.
1979 J.Fish.Res.Board Can., 36(7):855-8

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